UNIVERSITY OF CALIFORNIA,
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# Global Factor Returns

DISSERTATION

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for the degree of

DOCTOR OF PHILOSOPHY

in Finance

by

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# DEDICATION

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Cross-sectional equity anomalies

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"A Framework for Assessing Factors and Implementing Smart Beta Strategies," The Journal of Index Investing, Summer 2015, Co:authors: Jason Hsu, Vitali Kalesnik

"Momentum and Mean-Reversion in Commodity Spot and Futures Markets," Journal of Commodity Markets, September 2016, Coauthor: Denis Chaves

"The Low Volatility Anomaly and the Preference for Gambling," Risk-Based and Factor Investing, November 2015, Coauthor: Jason Hsu

"Anomalies in Chinese A-Shares," Journal of Portfolio Management, Summer 2018, Coauthors: Jason Hsu, Chenhui Wang, Phillip Wool

"Outperformance through Investing in ESG in Need," Journal of Index Investing, Summer 2018, Coauthors: Jason Hsu, Xiaoyang Liu, Keren Shen, Yanxiang Zhao

"Illiquidity and Factor Returns," Journal of Investment Management, October 2018, Coauthor: Jason Hsu.

# ABSTRACT OF THE DISSERTATION

Global Factor Returns

By

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The 86 of 97 McLean and Pontiff (2016) factors that can be readily tested internationally deliver higher returns in Developed ex US and yet higher returns in Emerging Markets than in the United States. An equally weighted portfolio of these factors is highly significant in each region and such portfolios in Developed ex US and Emerging Markets earn a significant alpha on their US counterpart. In no region are these factors adequately explained by current models that attempt to explain factor excess returns. These factors are driven by the underlying characteristics as opposed to loadings on risk factors demonstrating that these factors are anomalies, not priced risks. However, there is some evidence that the premia on these anomalies and the characteristics' ability to predict return are declining over time.

# CHAPTER 1: GLOBAL FACTOR RETURNS

The same factors that have been tested in the United States deliver high premia in developed markets excluding the United States (DevxUS) and yet higher premia in emerging markets (EM). This suggests that on average, the decline in factor premia in the United States is primarily a result of greater efficiency and not pure data snooping. In addition, it demonstrates that the behavioral inefficiencies in the United States are not specific to culture, economic structure, or regulations but instead reflect apparent failures of human rationality or attention in understanding universal economic phenomena.

I examine the robustness of factors by testing 86 of the 97 McLean and Pontiff (2016) factors across global markets and find that while most factors are insignificant in their own right, an equally weighted portfolio of factors is significant in each region and this portfolio is more significant in DevxUS than in the United States and more significant in EM than in DevxUS. Similar to Lu, Stambaugh, and Yuan (2018) for a smaller subset of factors and Jacobs and Müller (2019), I find that these anomalies are globally robust. Moreover, more factors are individually significant in EM than in DevxUS and in DevxUS than in the US. In addition, factors are more often significant and earn higher returns in small stocks than large stocks. Given the lower attention paid to and lower liquidity in smaller and emerging market stocks, this may be a function of limited attention or limits to arbitrage due to lower liquidity.

The factor performance in DevxUS and EM is not a mere result of correlation with US factors. An equally weighted portfolio of factors in DevxUS and an equally weighted portfolio of factors in EM each earns an alpha significant at a 0.01 level on the US equally weighted portfolio of factors.

The returns of these 86 factors are driven entirely by characteristics, not covariances. In other words, they are behavioral anomalies, not risk factors. Few factors built from factor loadings as opposed to characteristics are significant, whereas numerous factors built from characteristics are significant. An equally weighted portfolio of factors based on characteristics subsumes an equally weighted portfolio of factors based on covariances.

Moreover, the fact that 1) 17 principal components are needed to explain 90% of the variance of factor returns globally and 2) which factors deliver positive excess returns in any given period is time varying suggests that collapsing many factors into few may not be possible. Further, predictive regressions of returns demonstrate that the characteristics that predict return vary from period to period. All told, this suggests factors are robust globally and not subsumable by fewer factors.

As Harvey, Liu, and Zhu (2016) note, over a hundred factors have been discovered in the United States, but most no longer work and many never even worked in the sample in which they were originally investigated. This implies a collective data snooping by the academic and practitioner finance community. They suggest increasing the required t-stat to 3 for rejecting the null of 0 factor excess returns at a 0.05 level. However, it's not clear that such a high t-stat is actually warranted since many of the equity results they examined are time series claims, not cross-sectional ones. Moreover, I avoid this high t-stat requirement by equally weighting all factors into one portfolio in regions outside of the original test and post-sample, effectively collapsing the multiplicity of factors into one. However, the t-stats for the individual factors should be viewed with the suitable skepticism.

McLean and Pontiff (2016) examine 97 factor returns and find that t-stats have fallen in half post-sample. Such a result can either be a result of arbitrage as practitioners implemented

these anomalies or data mining as the high in-sample t-stats collapsed. The results in this paper suggest the decline is due to arbitrage at least in part.

Instead of looking post-sample, Linnainmaa and Roberts (2016) examine factor returns in a prior sample before the Compustat coverage period using Moody's Industrial and Railroad manuals. The pre-sample returns demonstrate that the factor returns were not robust. However, the United States may be sufficiently different between 1947 and 1965 that the same factors may not work. Of course, the exact same argument can be leveled against using international stock returns.

Lastly, Novy-Marx (2016) suggests that t-stats that account for multiple hypotheses would dismiss most false anomalies as data mining. He specifically targets composite factors such as Piotroski F-Score or Mohanram G-Score which contain multiple metrics in their construction. If a researcher has the choice to flip each element of a composite score to be positively sorted or negatively sorted, then even if each element is insignificant, the combination can be extremely highly significant. This fact remains true irrespective of the results presented here.

Instead of approaching the analysis of factors by looking pre- and post-sample, I choose to look outside the United States. Such an approach is necessarily riddled with data issues that prevent proper testing of all 97 McLean and Pontiff factors. In addition, testing the robustness of anomalies internationally does not have the same clean test of looking pre- and post-sample, since factors are correlated across regions.

One can rationally argue that investors behave differently in different regions and thus, different anomalies will naturally arise. This is likely true. Indeed, Arkes, Hirshleifer, Jiang, and Lim (2008) find cultural differences in reference point adaptation which should affect the momentum anomaly. Weber and Hsee (1998) and Hsee and Weber (1999) show that Chinese investors are more risk-seeking than American ones, which would affect the strength of the

volatility, beta, and residual variance anomalies. Ji, Nisbett, and Su (2001) find that Chinese students are more likely to believe that trends will continue than their American counterparts, which would affect momentum and reversal anomalies.

Some markets such as those in Taiwan are far more heavily dominated with retail investors than in the United States where most trading is done by institutions and increasingly by algorithms. Some countries have stricter accounting rules than others. Some demonstrate far greater earnings management than others. For example, most emerging markets show a stronger jump around 0% in a return on equity histogram than in the United States. However, if anomalies reflect something fundamental about human behavior whether driven by inattention, underreaction, overreaction, or risk preferences, then we would expect the anomalies to persist globally. In other words, if factors were not robust globally, it would not inherently suggest that they do not work in the United States. However, the fact that they do work globally suggests that they reflect something more fundamental as opposed to something specific to the United States and certainly refutes the notion that the historical literature on factors is a mere result of data-mining. This result and conclusion are the same of that of Jacobs and Müller (2019).

A second objection to using international data as a robustness test is that the returns are correlated with US data. As discussed, while correlated, an equally weighted portfolio of EM or DevxUS factors earns a significant positive alpha on an equally weighted portfolio of US factors, suggesting that an orthogonal component of the factors earns excess return.

Unlike many papers, I report large capitalization and small capitalization factor returns separately. The returns of large capitalization factors are generally lower than those of small capitalization factors similar to the results found in Hsu and Viswanathan (2018). The methodology involved in Fama and French (1992) and nearly every other paper on factors of

averaging large and small cap factor returns thus results in an exaggeration of the statistical significance of factors or at least an exaggeration of what can be practically earned by an investor of any reasonable size.

## 1.1 Data

I use Worldscope data for financial data and Datastream for market data. I match the adjustments that Compustat makes to ensure that the signals are comparably calculated. I choose Worldscope for financial data over other sources like Thomson Financial because Worldscope implements a litany of data adjustments to ensure comparability across countries.

I match Worldscope with Datastream through a matching table between DS Company Code and Worldscope ID, similar to CRSP / Compustat Merged. Country inclusion and classification into developed and emerging are based on MSCI. All non-OTC exchanges are included in each country. Country classification is based on country of domicile for the primary operating business of the firm as opposed to the exchange listing. Results are not sensitive to basing country designation on exchange.

A currency change in Brazil in the early 1990s results in a large bias in market capitalizations in the subsequent 4 years. Using other sources of exchange rates from Bloomberg fail to fully remedy this problem, so I start samples in July 1995.

I compare total returns and price returns for individual stocks. If total return exceeds price return in a day by more than 500%, then the total return is set to equal the price return. Presumably, no firm would pay out such a high percentage of its value as a dividend in one day, so such an observation is likely a data error. Bloomberg and CRSP data verify that such data are likely erroneous. If price returns ever exceed total returns, then price returns are set to total return. Lastly, if return exceeds 2500% or is less than -96% in a day that return is set to 0. These values are chosen

for symmetry in effect on geometric return. Again, the presumption is that returns above 2500% or below -96% are erroneous, which I verify in the US using data from CRSP and Bloomberg. If any total or price return data are missing, the returns are set to 0.

I use the market capitalization breakpoints for the NYSE from French Data Library. Only stocks above the 20th percentile are included (all but tiny). The rationale for the exclusion of such stocks are the sheer number of such stocks and the frequency of outlier returns among such stocks. I use NYSE breakpoints, since the inclusion of new exchanges in the database affects the distribution of market capitalizations dramatically. Market capitalizations in USD come from Datastream.

Certain factors from McLean and Pontiff (2016) are not computed due to lack of data: Change in Recommendation, which requires analyst recommendations; Debt Issuance, which requires debt issuance from the cash flow statement; Exchange Switch; IPO + Age, which requires the initial public offering of the company; Mergers; Ratings Downgrades; SEOs; Spinoffs; Advertising/MV because advertising is not broken out as a separate line item in Worldscope; Marketing/MV because marketing is not broken out as a separate line item in Worldscope; and G-Index, since it requires specific information about corporate governance.

While I do not compute IPO + Age, I do compute the IPO factor and Age factor individually by using the months since appearance in the database as a proxy. In order to prevent issues arising from new exchanges being added to Datastream causing a false positive for an IPO, no IPO or Age signals were calculated for any stocks that were added due to a new exchange being added to the database.

## 1.2 Factor Returns

### 1.2.1 Methodology

I test all anomalies for which data are available in McLean and Pontiff (2016). I choose McLean and Pontiff (2016) as the baseline because the anomalies are tractable and categorized. I use the categories merely as a tool for organization. The 86 anomalies tested are shown in Table 1 along with their corresponding citations.

As discussed previously, I remove tiny stocks from our sample as defined by below 20th percentile NYSE market capitalization. Next, I group stocks into large and small buckets based on total market capitalization with the NYSE 60th percentile denoting the breakpoint between large and small. I use 60th percentile as the demarcation point between large and small because the removal of tiny stocks shifts the market capitalization midpoint.

I sort stocks based on the given characteristic in the direction such that the long portfolio is expected to generate positive excess returns over the short portfolio. I base the sorting direction on papers that initially discovered the anomalies cited in McLean and Pontiff (2016). Unlike Jacobs and Muller (2019) I report the returns, volatilities, and t-stats of the individual factors including within large cap stocks, within small cap stocks, and the average of the large and small factors returns. The separation of the results is meant to elucidate the difference in returns of factors among large and small stocks. I average the large and small returns to produce the factor factors.

I also calculate the equal-weighted portfolio of all factor returns in a given region in the large, small, and average portfolios. The equally weighted portfolio of all factor returns represents the combined significance of all factors and is probably the cleanest determinant of whether factors as whole generate excess returns even if such a test tells us nothing about which factors generate excess return. Any given factor in a long list of factors can generate positive excess return. The

average of all factor returns in an out-of-sample test represents the ability of these factors to collectively predict return without the in-sample, outlier, or autocorrelated standard error problems that would occur with a regression.

For the purposes of the factor results, we construct size exactly as the other factors—top 30% minus bottom 30% within large and small. However, for the purposes of the explanatory regressions such as the Fama-French 3-Factor model, we construct size as top 40% minus the 20$^{th}$ to 60$^{th}$ percentile.

Unlike Jacobs and Muller (2019), I remove tiny stocks which are largely untradable but can make up a disproportionate component of stocks in the long and short portfolio as they are more likely to have extreme financial and market behavior. In addition, I aggregate stocks into the regions of US, DevxUS, and EM, which permits an interrogation of the orthogonal component of excess returns from EM with respect to the other regions.

### 1.2.2 Factor Returns Results Overview

Table 2 shows the number of significant factors in each region and size category. In general, factors in large capitalization stocks do not show particularly strong significance. At a 0.05 level, global large has 10 significant factors, US large 2 significant factors, DevxUS large 6 significant factors, and EM large 4 significant factors. Small cap stocks show far more significant factors across regions with 27 factors significant in global small, 8 significant in the US small, 23 significant in DevxUS small, and 36 in EM small. These small stocks generate an outsized influence on the significance of the average of factor portfolios within large and small. When one averages the large and small factors, 20 are significant in global, 5 in the US, 15 in DevxUS, and 19 in EM.

In general, the higher frequency of significant factors among small stocks is consistent with investors arbitraging these factors in large stocks but less so in smaller, more illiquid stocks. The outperformance among small stocks suggests that the factors are more likely to persist, given the lower liquidity of such stocks.

Factors are rarely negatively significant. Among the average of large and small factors, 2 are negatively significant at a 0.05 level in global, zero in the US, 3 in DevxUS, and zero in EM. This asymmetry suggests that the factors are more likely to deliver excess return than not but is hardly definitive given that many of the factors are highly correlated. I tackle this issue more rigorously when looking at equally weighted factors.

### 1.2.3 Global

Table 3 shows factor returns within each region and within large and small. Twenty factor returns are significantly positive at a 0.05 level or better among the average of large and small factor returns: change in asset turnover, change in forecast plus accruals, down forecast, one-year share issuance, total external finance, up forecast, coskewness, industry momentum, cash flow / MV, earnings-to-price, enterprise multiple, accruals, asset turnover, gross profitability, G-Score, F-Score, M/B and accruals, percent operating accruals, profitability, and ROE. Only two factors, bid-ask spread and cash flow variance, are negatively significant at a 0.05 level. Why bid-ask spread fails is not clear but is likely in part due to the sheer number of factors that are being tested—if enough tests are run, some are likely to show negative significance regardless of their actual expected return. Alternatively, it may simply be that illiquidity is not priced by the market. Brennan and Subrahmanyam (1996), Spiegel and Wang (2005), Ben-Rephael, Kadan, and Wohl (2015), and Lou and Shu (2014) find weak or no evidence for an illiquidity premium. Firms with low cash

flow variance tend to have low betas and to be growth firms, so the factor does not earn a significantly negative CAPM alpha or a significant Fama-French 3-Factor alpha.

### 1.2.4 United States

Factor returns in the United States during this period are weaker than those globally. Given that we are using a period between 1995 to 2018, our results are consistent with McLean and Pontiff (2016). That is, factors are relatively weak during this time period in the United States.

A mere 5 factors are positively significant at a 0.05 level when looking at the average of large and small: change in asset turnover, Mohanram G-Score, leverage, M/B and accruals, and percent operating accrual. Such a miniscule number of significant factors is consistent with none of the factors working in the US and the significant ones being the result of imprecise estimation on a finite sample. Two factors are significant in the large cap space: 5-year share issuance and NOA. Among small cap stocks, 8 of 86 factors are significantly positive at a 0.05 level, a mere 9% of tested factors.

The weakness in the US is telling. It is no wonder that numerous publications have claimed that the factors are likely a result of data mining and that markets are far more efficient than the sheer number of published factors would suggest. I will show in the Factor Equal-Weights subsection that there are significant returns to be found in this data and in the Collapsing the Factor Weights section that there are significant alphas in numerous factors.

No factors are negatively significant in the US.

### 1.2.5 Developed ex US

DevxUS shows greater factor significance than in the US. Fifteen factors are significant among the average of the large and small factor returns at a 0.05 level: change in forecast plus

accruals, down forecast, total external finance, up forecast, 52-week high, coskewness, industry momentum, cash flow / MV, dividend yield, earnings-to-price, enterprise multiple, F-Score, profit margin, profitability, and ROE. Three factors are negatively significant: bid-ask spread, Herfindahl, and tax. As globally, bid-ask spread is seemingly priced in the opposite direction. Lev and Nissim (2004) find that Tax, the ratio of tax-to-book income, predicts subsequent 5-year earnings growth and suggested that investors are becoming more aware of this relationship. At least in DevxUS, either this economic relationship has flipped or investors are now overreactingg to the relationship.

Six factors are positively significant in the large cap space while 23 are significant in the small cap space.

### 1.2.6 Emerging Markets

Within EM, 19 factors are significant at a 0.05 level when looking at the average of large and small cap returns: change in asset turnover, change in forecast plus accruals, down forecast, post earnings drift, R&D increases, up forecast, coskewness, long-term reversal, momentum-reversal, book-to-market, cash flow / MV, dividend yield, earnings-to-price, enterprise multiple, organizational capital, sales / price, asset turnover, operating leverage, and profitability. No factors are negatively significant in emerging markets for the average of large and small factors.

Within the large cap space, 4 factors are positively significant at a 0.05 level or better, while in the small cap, 36 are positively significant.

### 1.2.7 Factor Equal-Weights

A natural issue with the above results is that I am testing numerous hypotheses but still merely demanding a 1.96 t-stat threshold that would be used for a single hypothesis test. But while

any individual factor cannot be said to be significant at a 5% level with a t-stat of 1.96 given the many hypotheses that are being tested, an equally weighted portfolio of factors is not subject to this issue. This same approach was used by Jacobs and Muller (2019). Testing equally weighted factor portfolios involves 12 correlated hypotheses for each of the four tested regions in large, small, and the average as opposed to the 1,020 correlated hypotheses involved in testing 86 factors in four tested regions in large, small, and the average of the two.

This averaging approach also sidesteps the Novy-Marx (2016) objection about testing multiple signals. This does not involve choosing the factors that have done well in-sample by flipping the signs of factors if they perform negatively. I simply implement all factors as they are implemented in their original research in the United States and average them. While this suffers from publication bias in the United States for all factors published after July 1995, the problem is far less pronounced outside the United States.

Moreover, this approach handles the issue of the low signal-to-noise ratio for any given factor. If all factors are equally weighted, the collective signal remains while the individual noise cancels out.

Table 4 shows the results of this analysis and demonstrates that the factors are significant in every region, are more significant in small cap stocks than large cap stocks, and among average of large and small factors, are more significant in EM than in developed markets. An equally weighted portfolio of factors in US Large delivers 11 bps per month which exceeds DevxUS at 9 return, but both are exceeded by EM large at 13 bps. An equally weighted portfolio of factors in US small earns 12 bps compared to a 15 bps in DevxUS small and 23 bps in EM. In all regions, the equally weighted portfolio is more significant in small than large.

Note that the magnitude of these returns and volatilities is small due to averaging. Averaging long 100%, short 100% factors reduces absolute weights greatly over 86 factors.

The significance of the equally weighted factor returns in each region and globally suggests that the discovery of the myriad factors globally cannot be mere acts of data mining. If that were so, factors discovered and tested in the United States using CRSP and Compustat data would show no significance globally. Again, this agrees with Jacobs and Müller (2019). Moreover, the increasing significance from markets with more attention and liquidity such as large cap US equities to markets with less attention and liquidity such as small cap emerging market equities suggests that the factor returns are driven by market inefficiencies and limits to arbitrage.

This finding is in line with limits to arbitrage (Shleifer and Vishny (1997)) and limited attention (Hirshleifer and Teoh (2003)) such that factor returns are more likely to be strong among small, illiquid firms that are difficult to short than large, liquid firms where arbitrageurs can easily exploit anomalies.

Surprisingly, in emerging markets, the volatility of factors is slightly higher among large cap stocks than among small cap stocks, despite the fact that the volatility of small cap stocks tends to be higher than that of large cap ones. This may partly be driven by the greater number of securities in the small cap space, which generates far greater diversification. Alternatively, perhaps small stocks are more similar to each other and therefore tend to co-move more, resulting in a long-short portfolio hedging out this risk more greatly in small cap stocks.

On a similar note, the volatility of factor portfolios within EM, though higher than that of DevxUS, is lower than that of the US. Again, it may be the case that the higher individual stock volatility in EM is driven by components that are hedged out in a long-short portfolios whereas the volatility of factors in the US remain undiversified away in long-short portfolios.

### 1.2.8 Alpha Against United States

A concern that can be raised to the prior results is that DevxUS and EM factors are correlated with those of the US and thus these returns are not out-of-sample. To mitigate this issue, I examine DevxUS and EM equally weighted factor portfolios alphas against the same such portfolio in the United States in Table 5. All regressions are against the equally weighted factor portfolio in corresponding size bucket in the US. For example, the equally weighted factor portfolio in DevxUS large is regressed against the equally weighted factor portfolio in US large.

The only region / size group that fails to earn a statistically significantly positive alpha on the corresponding US portfolio is DevxUS large, which earns a 2 bp monthly alpha (t-stat: 0.88). The equally weighted portfolio of factor returns in global large earns a 4 bp monthly alpha (t-stat: 2.14) and EM large a 9 bp monthly alpha (t-stat: 2.11) on the corresponding US large portfolio. The portfolio in global small earn a 9 bp monthly alpha (t-stat: 4.62) against the US small portfolio. The DevxUS small portfolio earns a 9 bp monthly alpha (t-stat: 3.50) against the US small portfolio. The equally weighted portfolio of factor returns in EM small earns 20 bp alpha (t-stat: 4.98) against that of US small. The R-squared of the equally weighted portfolio of factor returns in a given region regressed against the same portfolio in the US is lower in EM than in DevxUS—21% in the average portfolio for EM and 61% for DevxUS. Global factors have a high correlation with US factors because the US makes up a large portion of global market capitalization.

### 1.2.9 Post-Sample Returns

Another potential objection to these results is that they are not post-sample. Table 6 shows the post-sample equally weighted portfolio results. Post-sample is defined by the first January after the original paper's sample period. Sample periods are defined as in McLean and Pontiff (2016).

Similar to Jacobs and Müller (2019), all region / size buckets are significant, though most buckets have lower significance than in the full sample shown in Table 4.

### 1.2.10 Covariances vs. Characteristics

Instead of sorting on characteristics, I sort on factor loading in each region in Table 7. For each stock, I calculate the full period factor loading against the market and one of the 86 factors in a bivariate regression. I use the average of the large and small factor as the regressor regardless of whether a large, small, or average factor is tested. I use a full period regression, because I am testing an asset pricing claim as opposed to a predictive claim. The look-ahead bias in a full period regression is not relevant since my goal is to test whether the loading on a factor delivers a particular return as opposed to whether a trader in a given time with the information at hand could earn excess returns by estimating factor loadings.

When using covariances, far fewer factors are significant. Among global large, three factors, earnings surprise, profitability, and ROE are significant at a 0.05 level. Among global small factors and global average factors, earnings surprise, 52-week high, profitability, and ROE are significantly positive while dividend initiation is significantly negative.

In the US, earnings surprise is significantly positive in the large, small, and average portfolios. Profitability is positively significant among small stocks. Leverage is negatively significant in both the small and average portfolios. In DevxUS, earnings surprise, 52-week high, profitability, and lagged momentum are significant in all size demarcations. Change in profit margin, profit margin, and ROE are significantly positive in the large and average portfolios. Earnings consistency is negatively significant in all size demarcations. Percent total accrual is negatively significant in the large and average portfolios while leverage and size negatively

significant in the small and average portfolios. Momentum-reversal is significantly negative in the average portfolio.

In EM, dividends are significant at a 0.05 level among small stocks, 52-week high is significant in the average portfolio, lagged momentum is significantly positive in the large and average portfolios, momentum is significant in all size categories, and earnings-to-price is significant among small stocks. Leverage is negatively significant among large stocks.

Table 8 shows that an equally weighted portfolio of factors built from covariances delivers significantly positive returns in EM small and average but nowhere else. Furthermore, these returns are subsumed by an equally weighted portfolio of characteristic factors. Table 9 Panel A shows that in all region / size buckets, except emerging markets large and small a portfolio built from covariance factors earns a significantly negative alpha, while Table 9 Panel B shows that a portfolio of characteristic factors earns an alpha on a portfolio of covariance factors in every region / size bucket. In other words, factors are driven by characteristics, not covariances.

The results in Table 8 are largely unchanged when using other periods of time to generate covariance estimates such as trailing 5 year or a 10-year period that includes the trailing and future 5-year period.

### 1.2.11 Long vs. Short Returns

Numerous papers find that factor returns are driven more by the short side of the portfolio than the long side. In particular, the return of the capitalization-weighted market portfolio minus the short portfolio's return is greater than the long portfolio's return minus the capitalization-weighted market portfolio. Table 10 shows the percentage of return that comes from the long side of the portfolio as a percentage of the total factor return. The number is subject to outliers since the factor return may be close to 0. However, the median value is above 50% in each region / size

bucket suggesting that most of the return comes from the long and not the short portfolio. In US Large, the median factor has 50% of the excess return originating from the long and 50% from the short. In EM Large, the median factor has 63% of the excess return originating from the long and 37% originating from the short. If limits to arbitrage are preventing these factor returns from being earned, those limits cannot be mere shorting constraints, since the long side of the portfolio contributes half or more of the excess return.

### 1.2.11 Factor Volatilities

Table 11 shows the factor volatilities. The long-only market portfolios show a pattern of increasing volatility from US to DevxUS to EM during this period with a 4.2% monthly volatility in the US, 4.5% in DevxUS, and 6.4% in EM. While EM factors are the most volatile, DevxUS factors are less volatile than the US ones. Among the average of large and small factors, 78% are less volatile in DevxUS than in the US and 23% are less volatile in EM than in the US. The average of the monthly factor volatilities in the US is 2.80%, in DevxUS 2.29%, and in EM 3.31%.

Table 4 shows that the volatility of the equally weighted factor portfolios is highest in the US at 0.73%. The equally weighted factor volatility in DevxUS is 0.57% and in EM is 0.63%. In other words, the correlation among the factors in EM is lower than the correlation among factors in the US, such that factor diversification benefits in EM are higher. This phenomenon is manifested again in the principal component analysis performed later in Chapter 2.

## 1.3 Determining Which Factors Deliver Excess Return

While I show that an equally weighted portfolio of factors deliver returns, I do not indicate which factors have higher premium. I show here that this question cannot be answered using historical average return or Sharpe Ratio. In particular, a portfolio that buys the top 30% of factors

with the highest historical mean return and shorts the bottom 30% of factors with the lowest historical mean return performs does not deliver positive returns generally.

Table 12 shows that in global large and the average of global large and global small, this strategy of choosing factors that have historically performed well and selling factors which have historically performed poorly delivers negative insignificant returns. In the United States, such a strategy produces negative returns in all size categories, significantly so in large stocks. Developed ex US shows significantly positive returns in small but insignificant returns in large and average. In Emerging Markets, returns are insignificant in large and average and significantly positive in small. In short, betting on the factors that delivered the highest historical return does not pay off.

Similarly, inconsistent results hold if we use historical Sharpe Ratio instead of historical mean return, though in this case, global small, DevxUS small, and EM small all show significantly positive returns to choosing the best performing factors and shorting the worst performing ones. The broad conclusion is that future factor return cannot be predicted using inception-to-date mean return. This isn't to say that factor returns are unpredictable, just that one cannot determine which factors will deliver excess returns using historical mean return or Sharpe Ratio, the latter of which is equivalent to comparing t-stats for factors with equal numbers of observations.

This claim is seemingly inconsistent with the notion that these factors deliver excess returns, since I claim factors deliver excess return because of their historical excess return and yet their historical excess return is not an indication of future excess return at any given time. Instead, what may be occurring is that these factors all have roughly the same positive expected return and any difference in trailing return is more likely to reflect noise than any particular signal.

## 1.4 Indicators of market efficiency

I examine aspects of US, DevxUS, and EM markets that might indicate either limits to arbitrage or lower attention. While such illustrative data is insufficient evidence to make firm claims, they do support the notion that less attention is paid to emerging markets and that there are likely greater limits to arbitrage at least as evidenced by lower trading volume in emerging markets.

Using market capitalization-weighted institutional ownership of the top 4000 stocks by float-adjusted market capitalization from Bloomberg[1], the US has averaged 81% institutional ownership between April 2010 and November 2018, DevxUS 49%, and EM 49%. Globally, institutional ownership has averaged 65%. Note that institutional ownership includes state-owned enterprises, possibly explaining the fact that EM and DevxUS have similar institutional ownership.

Globally, among these stocks, institutional ownership increased from 57% to 72% between April 2010 and November 2018. In the US, it remained roughly the same dropping from 85% to 84%. It increased from 45% to 56% in DevxUS and from 37% to 55% in EM.

Monthly trading volume summed across all stocks in 1996 averaged $559 billion in the US, $315 billion in DevxUS, and $84 billion in EM excluding Brazil[2]. By 2018, trading volume averaged $4,752 billion in the US, $1,530 billion in DevxUS, and $780 billion in EM excluding Brazil. Volume may be a proxy for attention and limits to arbitrage.

I/B/E/S coverage may be a proxy for attention. However, they cover 22,000 active companies but Worldscope shows 35,201 active companies in fiscal year 2017 among emerging and developed markets. In the US, IBES coverage starts at 36% in 1995 and increases to 48% by 2018. In DevxUS, IBES coverage starts at 25% in 1995 and drops to 22% by 2018. In EM, IBES

[1] The number 4000 was chosen due to Bloomberg download limits. While top 4000 was used as a cutoff for downloading, as long as a stock was once in the top 4000, it is subsequently used for analysis.
[2] Early trading volume data from Brazil on Datastream is questionable.

coverage was 21% in 1995 and drops to 16% by 2018. These drops in percentage coverage are due to new listings that aren't covered by I/B/E/S or new exchanges being added to the database at lower coverage, not absolute drops in number of stocks covered.

## 1.5 Are markets becoming more efficient?

Given the results of McLean and Pontiff (2016), it may be the case that markets are becoming more efficient over time. I test this hypothesis by regressing equally weighted factor portfolios and long-short portfolios built from expected returns against time:

$$R_t = \beta_0 + \beta_{Decay} Date_t + \epsilon_t$$

$R_t$ is the factor excess return in time $t$ and $Date_t$ is the date at time $t$ represented in days since January 1, 1900. The dates are divided by one million for scaling. A coefficient of 2 corresponds to a factor excess return decay of 7.3 bps per year.

For $R_t$, I use each of the following:

1) an equally weighted portfolio of factors

2) long-horizon mispricing, a long-short portfolio built from expected returns using inception-to-date average coefficients of a regression predicting return using anomaly characteristics

3) short-horizon mispricing, a long-short portfolio built from expected returns using the most recent coefficients of a regression predicting return using anomaly characteristics

Table 13 reports the results of these regressions. All coefficients regardless of size, region, or method of construction are negative, except for the DevxUS small long-short portfolio created out of inception-to-date average coefficients.

For an equally weighted portfolio of factors, none of the coefficients are significant at even a 0.10 level though all coefficients are negative. A long-short portfolio of expected returns using inception-to-date coefficients shows 0.05 significance in DevxUS large and 0.10 significance in global large and EM large. Using the most recent coefficients, $\beta_{Decay}$ is significant at a 0.01 level for global small and average and DevxUS large, small, and average. $\beta_{Decay}$ for US small and EM small and average is significant at a 0.05 level. $\beta_{Decay}$ for global large and EM large is significant at a 0.10 level.

The decay appears to be stronger when using the most recent coefficients as if the market has become savvy to the short-term mispricing but not the long-term structural mispricing, although the evidence remains too weak to make such sweeping generalizations. However, there is some weak evidence that anomaly returns are decaying over time.

## 1.6 Transaction Costs

Due to lack of bid-ask spreads for all stocks, I am unable to measure transaction costs reliably. However, Table 14 shows monthly one-way turnover, which should ceteris paribus be linearly related to transaction cost. Factors seem to break cleanly into low turnover and high turnover factors. For example, among global stocks, slow-moving characteristics like 5-year share issuance, beta, organizational capital, or Herfindahl (industry diversification) generate monthly one-way turnovers of 5%, 6%, 3%, and 4%, respectively. Fast-moving characteristics like short-term reversal, down forecast, up forecast, and coskewness generate monthly one-way turnovers of 147%, 110%, 111%, and 144%, respectively. Assuming a 100 bps transaction cost per 100% one-way turnover, these high turnover factors would universally generate a negative return.

## 1.5 Conclusion

The results for factor returns globally suggest that factors are not only robust outside of the United States but are stronger outside the United States and stronger in markets broadly thought to be less efficient like small capitalization stocks and emerging market stocks. This suggests that the lower factor returns post-discovery found by McLean and Pontiff (2016) are likely due to arbitrage as opposed to data mining since the factors deliver excess returns globally post-discovery.

Moreover, in all regions, even within the US, an equally weighted portfolio of factors earns a highly significant alpha on every model currently used to explain anomalies. An equally weighted portfolio of factors in DevxUS and EM earned a significant alpha on such a portfolio in the US, suggesting the international factor returns arise from an orthogonal source.

I find that factors are driven by characteristics, not covariances. Consequently, factors built from expected returns based on characteristics subsume simple equally weighted portfolios and perform best when explaining factor returns.

Taken together, these results demonstrate that factors deliver excess returns globally, that there are significant components of factor returns outside the United States that are orthogonal to factor returns in the United States, and that factor returns as a whole cannot be explained by a handful of factors. The "factor zoo" bemoaned by Cochrane (2011) is even more multitudinous than previously thought.

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# CHAPTER 2: HIGH-DIMENSION FACTOR RETURNS

While attempts have been made to collapse the factor space in the United States to a handful of factors, I find that these models fail to explain factor returns both within the United States and within Developed ex U.S. (DevxUS) and Emerging Markets (EM). Many such papers attempt to only explain significant factors, but models that explain returns can give significant alphas to insignificant anomalies. CAPM is the biggest such culprit. Most factors have a negative CAPM beta, so controlling for market excess returns immediately generates numerous significant alphas. It's generally the case that models aiming to control for factor returns tend to increase rather than decrease the number of significant factors.

Cochrane (2011) worries about the proliferation of factors which he termed a "factor zoo." The rational models of human behavior cannot justify the existence of so many factors. The literature broadly takes two approaches to tackling this problem: collapsing the factor space into far fewer factors or showing that the factors never existed and are the mere result of data mining. McLean and Pontiff (2016), Harvey, Liu, and Zhu (2016), and Linnainmaa and Roberts (2016) take the latter approach. McLean and Pontiff (2016) show that factor t-stats halved post-sample in the United States but wearere agnostic as to whether this came from inadvertent and collective data snooping or from arbitrage post-publication. Harvey, Liu, and Zhu (2016) argue that t-stat thresholds should be much higher given the number of hypotheses being tested, suggesting that most factors that have been found do not meet the new t-stat threshold and thus likely do not earn a premium. Linnainmaa and Roberts (2016) look at pre-sample factor returns and find that many factors were insignificant pre-sample again suggesting data snooping. However, Jacobs and Müller (2019) and the first chapter of this thesis show that these factors worked internationally even out-of-sample suggesting that they cannot be the mere result of data snooping. In addition, I find that

factor premia tend to be more significant in emerging markets and small cap stocks, suggesting that limits to arbitrage allow the premia to persist in these universes.

If factor premia are not a mere result of data snooping, then the alternative approach to mitigating the factor zoo is to explain many factors with fewer factors. That is, perhaps the 97 factors of McLean and Pontiff (2016) are really 3, 4, or 5 factors and can be simply explained away by these fewer factors. Fama and French (1992) explain several other value factors with their more parsimonious 3-factor model. The Carhart (1997) 4-factor model adds a momentum factor to explain mutual fund persistence in return. There was a considerable gap in such multi-factor models meant to collapse the factor space since Carhart (1997) as more papers were published proliferating the factor space as opposed to attempting to collapse it. The Fama and French (2015) 5-factor model uses market, value, size, operating profitability, and investments to explain factor returns. Hou, Xue, and Zhang (2017) use market, size, return on assets, and asset growth to explain returns. Novy-Marx (2013) uses market, size, asset growth, and return on assets. Stambaugh and Yuan (2014) use market, size, management, and performance, where management and performance are built from a cluster of factors. Daniel, Hirshleifer, and Sun (2018) use market, post-earnings announcement drift, and share issuance to explain factor returns.

I show that these models do not explain factor returns in all regions. Moreover, they appear to generate significant alphas among factors that do not have significant returns in their own right. This is a key finding, since several of the above papers restricted their analysis to only factors that earn significant returns in their own right. Coming to a similar vein but using a different approach, Kozak, Nagel, and Santosh (2018) find that factor returns cannot be explained with a characteristics-sparse SDF in the U.S. However, they do find that a few principal components of factor returns can explain factor returns well.

If the multitude of factors cannot be explained by data snooping nor can they be collapsed by a handful of factors, then factors are indeed multitudinous. An alternative theory is necessary to explain such behavior. It is unlikely the case that investors have a precise and multitudinous set of risks that they are price these 97 factors. However, I do not attempt to posit a theory as to how there can be so many anomalies in the market.

## 2.1 Data

As in Chapter 1, I use Worldscope data for financial data and Datastream for market data. I also employ the same data cleaning procedures including only including all but tiny stocks as defined by stocks with 20$^{th}$ percentile NYSE market capitalization and above. Factor returns are similarly calculated as top 30% minus bottom 30% on a given characteristic.

## 2.2 The Capital Asset Pricing Model (CAPM)

I devote a section specific to the Capital Asset Pricing Model (CAPM), because numerous factors that do not have significant returns in their own right have significant CAPM alphas, and this fact demands an explanation. Consistent with Liu (2019), Table 15 shows that many factors have predictable and persistent negative betas. For example, highly profitable firms and firms near their 52-week high have lower betas than less profitable firms and firms far from their 52-week high. Consequently, the CAPM alphas are higher than the monthly returns of those factors.

Many of the factors that have been discovered are quality factors. Insofar as these good features push a firm farther away from default, then by Merton (1974), these firms should have lower volatility and beta *ceteris paribus.*

In Table 15, I show that most factors have a negative beta. Speaking just among average factors, 73% (z-score of 4.27 for difference from 50%) have negative beta among global stocks,

66% (z-score: 2.97) in the United States, 78% (z-score: 5.19) in Developed ex U.S., and 60% (z-score: 1.85) in Emerging Markets. Because market returns are on average positive, this results in more factors having significantly positive alphas than significantly positive returns. Even if a factor's beta is positive and the factor's return is insignificant, its CAPM alpha can be significant since the market beta may explain sufficient variance of the factor to make up for the lower mean return.

While 18 factors are significant in their own right globally at a 0.05 level, 29 factors have significant CAPM alphas. In the US, there are 20 significant CAPM alphas compared to only 4 significant factors, in DevxUS, 26 significant CAPM alphas to 12 significant factors, and in EM, 26 significant CAPM alphas to 23 significant factors. Interestingly, though more factors are significant in EM than any other region, EM does not have more significant CAPM alphas than other regions. Indeed, this is true of all model alphas, not just CAPM. This suggests that the market is accounting for more of the variation in the factor returns in the US than in DevxUS than in EM. However, the introduction of CAPM makes factor returns that much more puzzling. There are more rather than fewer factors to explain.

## 2.3 Collapsing the Factor Space

I utilize the methodologies of papers that have attempted to explain factor returns using a handful of factors. Globally, these results do not hold, but more particularly, factors that are insignificant can earn significant alpha once controls are added. Hou, Xue, and Zhang (2017) measure alpha of significant factors against their model but do not look at the alpha insignificant factors.

Tables 16, 17, 18, and 19 show the global, US, DevxUS, and EM alphas, respectively, of the 86 factors using various models. The first model we use is CAPM (Sharpe (1964), Lintner

(1965)) which regresses the excess return of the factors on the excess return of the value-weighted market. In this case, the market is the value-weighted returns in a given region. Because all returns are stated in USD, I use the USD risk-free rate from the French Data Library. Table 20 shows the summary data on alpha significance using various models.

### 2.3.1 Fama French 3-Factor Model (FF3)

The 3-Factor model of Fama and French (1992) includes value in the form of book-to-market and size as measured by negatively sorted market capitalization. Surprisingly, there are more significant FF-3 alphas than CAPM alphas, even in the US.

Globally, there's no obvious pattern for which factors have significant FF3 alphas but not CAPM alphas. Post earnings drift, revenue surprises, age-momentum, and operating leverage have positively significant FF3 alpha but insignificant CAPM alpha.

Overall, there are 38 significant alphas globally at a 0.05 level, 29 in the US, 29 in DevxUS, and 29 in EM.

### 2.3.2 Carhart 4-Factor Model

The Carhart (1997) 4-Factor Model adds momentum as defined by past 12-month return excluding the most recent month. Note that this momentum is different from the momentum measure used by McLean and Pontiff (2016) and originally Jegadeesh and Titman (1993), who use the past 6-month return. Market anomalies such as 52-week high, age-momentum, coskewness, industry momentum, lagged momentum, price, and volume trend are explained by the addition of momentum.

Carhart performs better than either the CAPM or the FF3 model with 29 significant anomalies globally, 24 in the US, 20 in DevxUS, and 23 in EM.

### 2.3.3 Fama French 5-Factor Model (FF5)

The Fama and French (2015) 5-Factor model performs better than FF3 and CAPM but not the Carhart model. FF5 explains some valuation anomalies like cash flow / MV, dividend yield, and earnings-to-price, but causes the leverage component of B/P, organizational capital, and R&D/MV to gain significant alphas that were not significant in FF3 or CAPM. Ironically, despite having an investment factor in the form of asset growth, the investment factor from Titman, Wei, and Xie (2004) manages a significant FF5 alpha globally. The Titman, Wei, and Xie (2004) investment factor is measured by capital expenditures scaled by revenue divided by the average of the prior 3 years capital expenditures scaled by revenue.

Overall, the FF5 model has 32 significant alphas globally at a 0.05 level, 17 in the United States, 25 in DevxUS, and 14 in EM.

### 2.3.4 Novy-Marx 5-Factor Model (NM)

The Novy-Marx (2013) 5-Factor model adds gross profitability to the Carhart 4-Factor model. It explains seven additional anomalies over the Carhart 4-Factor model but also introduces significant alphas to eight anomalies which had insignificant Carhart 4 alphas. Factors that have significant Carhart 4 alphas but are explained by NM include post earnings drift, repurchases, accruals, asset turnover, forecast dispersion, percent operating accrual, and Z-Score. The nine anomalies explained by Carhart but not NM are age-momentum, Amihud's measure, volume, volume variance, volume / MV, dividends, change in capital expenditures versus the industry average, and dividend yield.

The NM model has 30 significant alphas in global, 19 in the US, 17 in DevxUS, and 22 in EM.

### 2.3.5 Hou, Xue, and Zhang 4-Factor Model (HXZ)

The Hou, Xue, and Zhang (2017) q-factor model includes the market, size, return on assets (ROA), and investments measured as asset growth. The ROE and investment anomalies are built using a 3 x 3 x 2 intersection with each other and size broken into large and small. Globally, this model explains less successfully than CAPM, leaving 34 positively significant anomalies to CAPM's 33, but it manages to find 6 negatively significant anomalies versus 2 for CAPM.

Negatively significant factors are theoretically as troublesome as positively significant ones if we believed them to continue to be negatively significant. Conceptually, it is still an anomaly—one just needs to flip the implementation. However, without a theoretical justification for why the factor should deliver a negative alpha after controlling for these specific factors, there is little sense in flipping the sign. The negatively significant factors under HXZ globally are dividends (whether the stock paid dividends over the prior 12 months), growth in long-term NOA, sustainable growth, bid-ask spread, price, seasonality, and volume. Asset growth shows a return negatively significant at a 0.10 level but is also one of the factors in HXZ. The HXZ implementation is created by creating a 2 x 3 x 3 intersection with size, asset growth, and return on equity. The negative alpha suggests that such an implementation subsumes the simple asset growth implementation with a 2 x 3 intersection with size and asset growth. Bid-ask spread is already negatively significant under the CAPM. None of the others have any obvious reason to deliver significantly negative alpha after controlling for the market, size, ROA, and investments.

HXZ leaves 34 factors significantly positive globally, 21 in the US, 9 in DevxUS, and 17 in EM. HXZ is the best at explaining DevxUS anomalies.

### 2.3.6 Stambaugh and Yuan 4-Factor Model (SY4)

Stambaugh and Yuan (2016) clusters a set of factors and used averages of factor returns within those two clusters to create a management and performance factor. They use market, size, management and performance to explain factor returns. Similar to HXZ, SY4 increases the number of significant alphas globally versus CAPM with 34 significant factors rather than CAPM's 33. SY4 suffers most in valuation anomalies, with analyst value, book-to-market, cash flow / MV, dividend yield, earnings-to-price, enterprise component of B/P, enterprise multiple, and sales / price all being positively significant while leverage component of B/P and R&D / MV are negatively significant.

Overall, SY4 leaves 34 factors significantly positive globally, 31 in the US, 24 in DevxUS, and 27 in EM.

### 2.3.7 Daniel, Hirshleifer, and Sun 3-Factor Model (DHS)

Daniel, Hirshleifer, and Sun (2018) use the market, post-earnings announcement drift, which captures short horizon mispricing, and the average of one-year and five-year issuance, which captures long horizon mispricing. The DHS model is most successful at explaining factors in the US relative to other models discussed thus far. Globally, among anomalies with significant CAPM alphas, DHS explains the repurchase anomaly, beta, idiosyncratic risk, max (also called the lottery effect), volume variance, dividend yield, sales / price, asset turnover, and forecast dispersion.

I maintain the signal in post-earnings drift until the subsequent announcement date due to the low I/B/E/S emerging market coverage and the need to calculate a signal in every month globally. I/B/E/S coverage is not as comprehensive globally as it is in the United States. If earnings are announced quarterly, the factor will stay long a stock that beat its earnings for roughly 3

months. This may hamper the ability of the Daniel, Hirshleifer, and Sun (2018) model to properly explain returns.

DHS leaves significant alphas in 31 factors globally, 12 in the US, 27 in DevxUS, and 22 in EM.

### 2.3.8 Characteristic 2-Factor Model

The third chapter of this thesis shows that we can subsume an equally weighted portfolio of factors using a factor from the predicted returns using inception-to-date average coefficients of the 86 underlying characteristics that went into these 86 factors. I use that factor and the market to explain the 86 factors. I create two versions of this two-factor model: a region-specific model where the long-horizon factor is created within each region and a global model where an average of US, DevxUS, and EM factors is used. The motivation for the former is that anomalies may have region-specific behavior. The motivation for the latter is simply finding a universal model. Of course, there is something that breaks the spirit of the game by using predicted returns using 86 characteristics as the basis for the factor, but I aim to further demonstrate the point that it is characteristics, not covariances, that drive return. That is, if an expected return model that incorporates all of the information in the factors to predict return out-of-sample subsumes the full set of factors, it suggests that the model can extract information from the full set of characteristics that doesn't exist in a mere handful. It demonstrates the futility of the exercise of collapsing the factor space through choosing a handful of factors.

Indeed, in every region, except DevxUS, the characteristic models beat out all the other models. In DevxUS, HXZ outperforms the global characteristic model. The region-specific model leaves 27 factors significant globally, 9 in the US, 23 in DevxUS, and 15 in EM. The global

characteristics model leaves 20 factors significant globally, 9 in the US, 10 in DevxUS, and 10 in EM.

### 2.3.9 Summary

Our results show that the factor space is not collapsible using the current methods. While some models are reasonably successful in some regions, every model leaves numerous anomalies unexplained.

However, the equally weighted portfolio of factors is even more difficult to explain as shown in Table 21. In every single size / region intersection and for every single one of the above models, the equally weighted portfolio earns an alpha significant at a 0.01 level with the only exception being the US for the characteristic models where the global model has an alpha significant at a 0.05 level. The global characteristic model has the lowest alpha among all the models in all regions.

In short, using predicted returns generally outperforms any single model but there are still significant factors. This is probably at least in part due to the relatively unsophisticated way of approaching return prediction. For example, Freyberger, Neuhier, and Weber (2019) and Gu, Kelly, and Xiu (2019) both suggest that non-linear methods perform better than linear ones in predicting returns. However, even this hobbled linear characteristics model outperforms all other models in explaining factor returns.

In the next section, I argued that it is unlikely that a handful of factors will explain all factor returns in the future at least in a linear model.

## 2.4 Principal Component Analysis

I run a principal component analysis (PCA) to determine how much of the variance of these factors can be explained by orthogonal components.

As shown in Figure 1, explaining 80% of the variance requires 8 components globally, 7 in the United States, 11 in Developed ex US, and 17 in Emerging Markets. Normalizing the variance of all factors to prevent large variance factors from dominating the PCA results in the number of factors needed to explain 80% of the variance to increase: 12 globally, 12 in the United States, 15 in DevxUS, and 20 in EM.

The sheer number of factors to explain these 86 factors coupled with the fact that historical performance is not a predictor of future performance for these factors suggests the variance of these factors cannot trivially be decomposed into a handful of sources. It does not inherently suggest that premia are associated with all of these components. However, factor premia are time-varying given that historical premia cannot accurately predict future premia. If factor premia are time-varying and numerous components are needed to explain their variance, then it is probable that their conditional returns are difficult to explain with a handful of static factors.

Moreover, this PCA likely understates the issue. Factor covariances are time varying. For example, value is positively correlated with low volatility during periods of stability but negatively correlated during periods of dislocation. If premia are associated with these factors during both periods of stability and dislocation, then the factor premia of value and low risk may only be explainable by one factor during stable periods.

It is important to note that the PCA is a stylized way of making this point. In theory, all factors could each have high uncorrelated volatility but be driven by one source of excess return with low volatility. In such a case, many principal components are necessary to explain factors but

only one variable could explain all factor returns. However, the sheer difficulty in explaining all factor returns suggests it is unlikely that this is the case.

## 2.5 Conclusion

Factor returns cannot be simplified to a sparse characteristics model globally. The number of principal components needed to explain the 86 factors in various regions is further evidence that the factor space cannot be easily collapsed. Indeed, the fact that a characteristics-based expected return model explains more factors than the sparse model and earns an alpha on an equally weighted portfolio of factors suggests that the entire notion of factors and factor models misses a more fundamental feature of the market. There are characteristics that predict return. These can be structured in factor portfolios but as long as it is characteristics and not covariances that predict return, these factor portfolios will miss the necessary controls against other factors and will lose information by rank ordering the characteristic instead of incorporating the characteristic itself into expected return.

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# CHAPTER 3: MACHINE LEARNING IN GLOBAL EQUITY MARKETS

Underlying stock characteristics predict returns globally through simple linear regressions, but this predictability is enhanced by using linear ridge, gradient boosting, and random forest. Moreover, calibration within emerging markets and developed markets produces better out-of-sample fit than global calibration suggesting that there is region-specific behavior in factor returns.

Jacobs and Muller (2019) and the first chapter of this paper show that the McLean and Pontiff (2016) factors generate excess returns globally and do so post-sample, demonstrating that the same inefficiencies that occur in the United States also occur globally. I shows that emerging market factor returns are greater than U.S. factor returns and earn a significant alpha on U.S. factors and that factor returns are larger within small cap stocks than large cap stocks, suggesting that markets typically thought of as less efficient earn higher factor returns as would be expected.

Lewellen (2015) used Fama-Macbeth predictions using 15 characteristics to show that U.S. stock returns are cross-sectionally predictable. Gu, Kelly, and Xiu (2019) showed that machine learning methods could enhance return predictability. In this paper, I first demonstrate that simple linear models can generate strong predictability in stock returns. The second chapter of this thesis shows that factor models built from these simple linear models can explain factor returns better than any of the popular sparse factor models used to explain returns. I then show that linear ridge predicts better than simple linear regression and in turn that gradient boosting predicts better than linear ridge. Random forest predicts similarly to linear ridge.

Linear ridge is simply a linear regression with a regularization parameter to prevent overfitting. This method is described in greater detail later. The fact that linear ridge outperforms linear regression suggests that a standard linear regression tends to overfit over the full dataset. Regularization mitigates this overfit. Gradient boost outperforms linear ridge. Gradient boosting

and random forest capture non-linear effects and interactions. The fact that these methods outperform suggests the importance of non-linearity and interaction in predicting returns.

In this paper, I use a wider range of characteristics than the prior chapters, which focused solely on McLean and Pontiff (2016) factors. Instead, I use the set of Hou, Xue, Zhang (2018) factors that can be calculated globally. Hou, Xue, Zhang (2018) includes all factors that are tested in the literature whether the author argues that they would generate expected returns or not. This much wider range of factors gives the predictive models more material with which to work and allows the models to decide whether the variables predict return. As I find in Chapter 1 with factor returns, creating long-short portfolios from expected returns delivers higher returns in EM than in DevxUS and in turn higher returns in DevxUS than in the US. Moreover, in a univariate regression, a long-short portfolio built from expected returns against characteristics subsumes an equally weighted portfolio of factors based on characteristics.

If one can determine which characteristics deliver expected return and the direction of the correlation with expected return but cannot determine the magnitude of the impact on expected return, then using cross-sectional regressions should perform no better or perhaps worse than the average of all factor returns. On the other hand, if characteristics differentially predict return, then the cross-sectional regressions should tease this out.

## 3.1 Data

As in the rest of this paper, I use Worldscope data for financial data and Datastream for market data. I also employ the same data cleaning procedures including only including all but tiny stocks as defined by stocks with $20^{th}$ percentile NYSE market capitalization and above. However, I utilize all calculable factors in Hou, Xue, Zhang (2018) and also separate factors into annually, quarterly, and monthly rebalanced.

## 3.2 Methodology

I use linear regression, linear ridge, gradient boost, and random forest to predict returns on a monthly, quarterly, and annual frequency. I use multiple frequencies in order to determine the effects of rebalance frequency on predicting return. For the annual prediction, I only use financial variables and variables that can be viewed as value factors, namely those that divide market capitalization by a financial variable. For monthly and quarterly prediction, I use both financial variables from quarterly financial reports as well as market variables. In addition, I remove any variables that have a quarterly autocorrelation below 0.3. This approach avoids high decay signals that will generate high turnover, ensuring that the factor returns can be earned in actuality and are not a mere artifact of high turnover characteristics. Such excluded low autocorrelation signals include short-term reversal and market co-skewness.

### 3.2.1 Data Pre-Processing

Instead of predicting return directly, I predict CAPM alpha since market volatility makes up a large portion of stock volatility and I am predicting cross-sectional returns. In addition, it is likely the case that predicting cross-sectional returns is easier than predicting market returns since market returns are subject to time-varying alpha and difficult to predict market-level shocks.

To process the data, we winsorize the alphas and signals at 1% and calculate z-scores for both alphas and signals. Note that we winsorize returns only for the sake of fitting. In the actual test of root mean-squared error, out-of-sample R-squared, and portfolio construction, I do not winsorize returns since even extremely high and low returns are part of the return space that investors experience. Of course, z-scores are calculated as follows:

$$z = \frac{x - \mu}{\sigma}$$

Here, $x$ is the vector for a given signal, $\mu$ is the mean of $x$ and $\sigma$ is the standard deviation of $x$.

### 3.2.2 Linear Regression

A standard OLS regression looks as follows:

$$y_i = \beta_0 + \sum_{p=1}^{P} \beta_p X_{pi} + \epsilon_i \quad i = 1,2,\dots,N$$

I use this model as a control since any benefit of regularization from ridge regression or interactions and nonlinearity from gradient boosting or random forest must come relative to the linear benchmark without regularization.

It is uncertain ex ante whether it is optimal to use an inception-to-date average or the most recent cross-sectional regression or some weighted average of regression coefficients across time. One would use inception-to-date averages if no regime switches were occurring and the coefficients were noisy estimates of their true values. One would use the most recent cross-sectional average if regime switches were extremely frequent but the coefficients were well-estimated in each period. Naturally, some weighted average would be optimal depending on the relative frequency and character of regime shifts and the error in period-to-period estimates. Alternatively, it may be that there are aspects of mispricing that are consistently made but aspects of mispricing that occur over short periods. In this case, both methods would produce significant returns but would be mostly uncorrelated. This latter case is indeed correct but using most recent coefficients to predict return is too high turnover to be practically implemented such that it represents a limit to arbitrage. I present both inception-to-date and most recent for linear regression but do not present most recent results using the other models.

### 3.2.3 Ridge Regression

As the number of predictors grows while the number of observations stays constant, a linear regression model is more likely to overfit the in-sample data and thus perform worse out-of-sample. This problem is particularly insidious in return prediction since the market is constantly trying to learn the correct price of assets which in turn reduces return predictability.

Ridge regression applies a penalty to fitting away from zero. In particular, any deviation from 0 is met with a penalty equal to the square of the coefficient times the regularization parameter $\lambda$. The objective function is:

$$\min_{\beta} \frac{1}{2N} \sum_{i=1}^{N} \left( y_i - \sum_{p=1}^{P} \beta_p X_{pi} \right)^2 + \lambda \sum_{p=1}^{P} {\beta_p}^2$$

Naturally, this will hurt the in-sample performance of the model mechanically but with a properly chosen $\lambda$ can improve out-of-sample fit. I chose a $\lambda$ of 10 for the models below.

### 3.2.4 Gradient Boosting

Both gradient boosting and random forest utilize decision trees. Decision trees take sequential subsets of the data cutting on a particular variable in each branching subset. For example, a decision tree could first cut on log market capitalization with firms with log market cap less than one standard deviation above average landing in one branch and those greater than one standard deviation above average landing in the other branch. The number of firms need not be the same in each branch. The high market cap branch could in turn branch on momentum with below -0.5 standard deviation momentum stocks in one branch and above in the other branch. The low market cap branch may simply end at that node. Calculating the expected return of a stock

involves tracing down the tree based on that stock's characteristics and calculating the average alpha of the leaf node in which the stock lands.

Gradient boosting uses decision trees sequentially. In each step of each tree it chooses the variable that will provide the cut that most differentiates the expected return at a particular cut. After it builds the first tree in this manner, it uses the residuals of the first are used as the dependent variable in the subsequent tree. To prevent overfitting, a learning rate between 0 and 1 is chosen. This learning rate acts as a multiplier on whatever the tree learns about returns in that step. A learning rate that is too high will overfit while a learning rate that is too low will underfit.

### 3.2.5 Random Forest

Random forest builds decision trees in parallel and averages the trees together. Both a subset of the data and a subset of predictors is chosen randomly for each tree. These approaches coupled with averaging many trees prevents overfitting. In fact, gradient boosting is more likely to overfit while random forest more likely to underfit. However, a random forest can still be overfit if given a large enough depth of tree.

The hyperparameters for random forest are the number of trees used, the number of features randomly selected for each tree, and the minimum node size of the last leaf. A low minimum node size allows for greater tree depth while a high minimum node size restricts the tree depth. I choose a number of trees of 200, a number of features of 5, and node size of 30.

### 3.2.6 Calibration and Prediction

I fit the models using ridge regression, gradient boost, and random forest with fixed hyperparameters cross-sectionally in each year, quarter, or month. This is the Fama and Macbeth (1973) approach to fitting, but I apply this technique for computational tractability. Haugen and

Baker (1996) and Lewellen (2015) also utilize this method as it gives equal weighting to each time observation regardless of the number of stocks in that time period.

With the fitted models for each month, I use a walk forward method to calculate the expected alphas, which predicts alphas in the subsequent period using the average of all prior period model's expected alphas for the given stocks. In particular, I use the following equation to predict alphas in period $t+1$:

$$\mathrm{E}(\alpha_{i,t+1}) = \frac{1}{t}\sum_{j<t} f_j(X_{i,t})$$

One shortcoming of walk-forward prediction is while it gives a good sense of the returns one could have earned historically they understate the expected returns of the model going forward. That is, in 2019, the model can utilize 23 years of data from 1986 to 2018. However, in walk-forward model, on average, the model is using 11.5 years of data.

To avoid this issue, we use a walk-around prediction with an embargo. This prediction procedure is different from the inception to date or current prediction method, which uses both past and future information. Here, alphas are predicted as follows:

$$\mathrm{E}(\alpha_{i,t+1}) = \frac{1}{t}\sum_{j\notin[t+1,t+13]} f_j(X_{i,t})$$

Here, an embargo is 12-month embargo added after the period of prediction. This embargoing of the data to prevent future data from leaking information into the past is suggested by Lopez de Prado (2018). Of course, a more salient question is whether it is generates look-ahead bias to bring predictions—even cross-sectional ones—from the future into the past. Of course, there is literal look-ahead bias to such behavior, but as long as cross-sectional data from the future is no more valuable than cross-sectional data from the past, this approach will provide a better estimate of future expected return. Moreover, using the same length of data as the current portfolio

allows better calibration of hyperparameters. However, I show the more conservative walk-around method as well, since that is less subject to the accusation of look-ahead bias.

### 3.2.7 Regularization Parameters

It is best practice to use a cross-validation set to choose hyperparameters. Certainly, choosing based on out-of-sample predictability *ex post* is bad practice for the simple reason that those out-of-sample returns are now no longer out-of-sample. An investor would not know the optimal hyperparameter in the moment.

Unfortunately, there is a second more practical consideration when calibrating machine learning models, namely computational time. For the sake of computational ease, I choose hyperparameters coarse enough that the model always chooses a given model in cross validation throughout the set. This has an advantage in computation time but also suggests that prediction can be improved through more precise cross-validation of hyperparameters.

### 3.2.8 Ensemble Forecast

I create ensemble forecasts using a linear combination of the linear ridge, gradient boosting, and random forest methods. This ensemble uses each of the 3 models' expected alphas as signals in a simple linear regression to predict alpha. The ensemble is generated in a similar way as the expected alphas of the underlying models. In each month, alphas are predicted as follows:

$$\alpha_{i,t} = \beta_{0,t} + \beta_{lr} E_{t-1}^{lr}(\alpha_{i,t}) + \beta_{gb} E_{t-1}^{gb}(\alpha_{i,t}) + \beta_{rf} E_{t-1}^{rf}(\alpha_{i,t})$$

Here $E_{t-1}^{lr}(\alpha_{i,t})$ is the expectation at time $t-1$ of alpha in time $t$ for stock $i$ using linear ridge, while $gb$ refers to gradient boosting and $rf$ to random forest.

### 3.2.9 Portfolio Construction

We compare the performance of the strategy in a long-short portfolio. The portfolio approach represents what can be earned by an investor utilizing these tools. I utilize this as opposed to out-of-sample R-squared or mean squared predictive error because, while these are interesting statistically, have less intuitive interpretations and less obvious ramifications for asset pricing.

## 3.3 Results

### 3.3.1 Linear Regression Results

Before I show the comparative analysis of the models, I show portfolios built from linear regression. I do not report the results of the regression since I winsorize returns. Instead, I create long-short portfolios from the predicted return for the subsequent period. I use two different sets of coefficients:

1) The most recent set of cross-sectional coefficients
2) The average of the inception-to-date cross-sectional coefficients

Table 26 shows the results of such methods. As in the first chapter, for an equally weighted portfolio of factor returns, performance is highest in emerging markets, second highest in developed ex US, and lowest in the United States, at least among average factor returns. Performance is higher in small than in large. Comparing to the first chapter, t-stats are higher using expected returns from cross-sectional regressions than straight averages of factors, suggesting that determining which characteristics will outperform is possible.

The inability to predict which factor outperforms but the ability to predict which characteristic will deliver return demands an explanation. It may be driven by the fact that characteristics, not factor covariances, drive returns as Daniel and Titman (1998) posit for size and

value and which I have shown to be the case more generally. Using factors ignores the predictive power that occurs in time varying distributions of characteristics. For example, the fact that book-to-market dispersion is lower may suggest that expected returns to value are lower. Regressions capture such nuance but factors do not.

Table 26 shows that these two methods—using inception-to-date averages for coefficients and using the most recent coefficients—each earns a significant alpha on each other and have relatively low correlation. The rationale for such a finding is that there are characteristics that are consistently mispriced and characteristics that are mispriced temporarily. The temporary mispricings occur at a longer than monthly basis, as mispricing in one month predicts the subsequent month's mispricing. I did not explore this further in this paper but this behavior is a fruitful area of potential research.

Another important facet of these two methods is that the equal-weighted portfolio of factors is correlated with the long-term mispricing factor but not with the short-term mispricing factor. This result is sensible since the short-term mispricing factor must be betting in the opposite direction of the traditional factor in many cases because it is not highly correlated with the long-term mispricing factor.

Moreover, the long-term mispricing factor largely subsumes the equally weighted portfolio of factors from Viswanathan (2019a) as evidenced by Tables 24 and 25. Table 24 shows that the long-term mispricing factor earns a significant alpha on the equally weighted portfolio in every region / size demarcation. Conversely, Table 25 shows that the equally weighted portfolio only earns a significant alpha on the long-term mispricing factor in EM Small. Note that the equally weighted portfolio earns a significant alpha once we account for market excess returns as a factor, a result discussed in the Collapsing the Factor Space section.

In order to determine whether there are region-specific effects, I fitted coefficients within US, DevxUS, and EM instead of using all global data. I then generate expected returns from these coefficients and created long-short portfolios from these expected returns using a similar method as above. Results are shown in Table 26. The factors produced from regionally calibrated expected returns produce higher returns among small stocks in all regions whether using just the most recent coefficients or the inception-to-date average coefficients. However, the performance from globally calibrated expected returns consistently produce higher returns among large stocks in every region and coefficient choice except DevxUS using most recent coefficients.

To determine whether the expected returns predicted using specific region data subsumes expected returns predicted using all stock data, I regress the long-short portfolios built from all data on the long-short portfolios built from only region-specific data within each region / size bucket in Table 27. Table 28 shows the reverse regression. The region-specific long-short portfolio earns a significant alpha on the global-calibrated long-short portfolio in all regions in the small category except for DevxUS using the most recent coefficients. The region-specific long-short portfolio earns no significant alphas among large stocks though all are positive. The global-calibrated long-short portfolios earn significant alphas on the region-specific long-short portfolios only in emerging market large, whether calibrated from full period or most recent data.

### 3.3.2 Machine Learning Models

Table 29 shows the returns for the annually rebalanced walk-forward prediction model. Most papers that approach return prediction predict monthly return and rebalance monthly. The purpose of showing annually rebalanced returns is to show a rebalance frequency whose returns will be largely unaffected by transaction costs. Panel A shows linear ridge. In large cap, returns are largely unpredictable even DevxUS and emerging markets. However, small cap stocks are

highly predictable everywhere except for the U.S. This pattern of small cap returns being far more predictable than large cap returns persists across the models with gradient boosting and random forest generally showing lack of predictability in large cap. The two exceptions are random forest and ensemble for EM large, which earn a return of 86 bps (t-stat: 3.45) per month and 72 bps (t-stat: 2.70), respectively. For annual prediction, gradient boosting performs similarly to linear ridge with solid prediction in small cap stocks. Random forest outperforms both gradient boosting and linear ridge among small stocks except in the United States. Ensemble forecast produce significant long-short returns in all regions among small cap.

Table 30 shows quarterly prediction which uses quarterly data and market variables. This massively delivers far stronger returns than annual prediction. For linear ridge, size buckets are significant in global, DevxUS, and EM, but none are significant in the US. Gradient boosting earns higher returns than linear ridge in every size / region bucket except in DevxUS Large. Random forest earns lower and less significant returns than linear ridge in all regions but emerging markets. Ensemble earns significant returns in all region / size buckets except for the US where only US small is weakly significant suggesting that US returns are largely unpredictable. Small cap long-short returns are always higher than large cap long-short returns. For any given size bucket, EM long-short returns are higher than DevxUS returns which are in turn higher than US long-short returns.

Table 31 shows monthly prediction which outperforms both annual and quarterly prediction. Indeed, all region / size buckets are significant at a 0.05 level except US Large for linear ridge, random forest, and ensemble forecast. US Large for linear ridge and ensemble are significant at a 0.10 level. Global, DevxUS, EM are significant at a 0.01 level for all size buckets.

Table 32, 33, and 34 show the walk-around prediction. Most of the results match that of the walk-forward analysis but the main takeaway is that the results are not helped markedly from the additional observations. Despite on average having 80% more observations on which to calibrate the models, the walk-around models are no more able to predict return than the walk forward models.

## 3.4 Conclusion

Stock returns are predictable and are aided by machine learning models. The greatest gains come from regularization even in a linear context but there appear to be non-linear effects and interactions that result in gradient boosting and random forest generally outperforming linear ridge. Returns are largely unpredictable among large cap U.S. stocks but all other region / size buckets show predictability at least at a monthly frequency. Annual prediction performs well among small stocks but no region or model shows consistent annual prediction among large stocks. Quarterly and monthly prediction performs well among all regions and sizes except for the US. US returns appear to be largely unpredictable at least as compared to DevxUS and EM. This general lack of predictability may explain the findings of McLean and Pontiff (2016) and Harvey, Liu, and Zhu (2016) that factors no longer work and appear to be data mined. My results are more consistent with the US reacting more quickly to publications about return predictability.

## 3.5 References

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# Appendix

Table 1: Signals and Authors

This table shows the signals and corresponding authors used in this paper. These signals are 87 of the 97 McLean and Pontiff (2016) factors.

| Signal | Author |
|---|---|
| 52-Week High | George and Hwang (2004) |
| Accruals | Sloan (1996) |
| Age | Barry and Brown (1984) |
| Age-Momentum | Zhang (2006) |
| Amihud's Measure | Amihud (2002) |
| Analyst Value | Frankel and Lee (1998) |
| Asset Growth | Cooper, Guylen, and Schill (2008) |
| Asset Turnover | Soliman (2008) |
| Beta | Frazzini and Pedersen (2014) |
| Bid/Ask Spread | Amihud and Mendelsohn (1986) |
| Book-to-Market | Fama and French (1992) |
| Cash Flow Variance | Haugen and Baker (1996) |
| Cash Flow/MV | Lakonishok, Shleifer, and Vishny (1994) |
| Change in Asset Turnover | Soliman (2008) |
| Change in Profit Margin | Soliman (2008) |
| Chg. Forecast plus Accrual | Barth and Hutton (2004) |
| Coskewness | Harvey and Siddique (2000) |
| ΔCapex - ΔIndustry Capex | Abarbanell and Bushee (1998) |
| ΔNoncurrent Op. Assets | Soliman (2008) |
| ΔSales - ΔInventory | Abarbanell and Bushee (1998) |
| ΔSales - ΔSG&A | Abarbanell and Bushee (1998) |
| ΔWork. capital | Soliman (2008) |
| Dividend Initiation | Michaely, Thaler, and Womack (1995) |
| Dividend Omission | Michaely, Thaler, and Womack (1995) |
| Dividend Yield | Naranjo, Nimalendran, and Ryngaert (1998) |
| Dividends | Hartzmark and Solomon (2013) |
| Down Forecast | Barber, LeHavy, McNichols, Trueman (2001) |
| Earnings Consistency | Alwathainani (2009) |
| Earnings Surprise | Foster, Olsen, and Shevlin (1984) |

| Signal | Author |
|---|---|
| Earnings-to-Price | Basu (1977) |
| Enterprise Component of B/P | Penman, Richardson, and Tuna (2007) |
| Enterprise Multiple | Loughran and Wellman (2011) |
| Forecast Dispersion | Diether, Malloy, and Scherbina (2002) |
| F-Score | Piotroski (2000) |
| Gross Profitability | Novy-Marx (2013) |
| Growth in Inventory | Thomas and Zhang (2002) |
| Growth in LTNOA | Fairfield, Whisenant, and Yohn (2003) |
| G-Score | Mohanram (2005) |
| Herfindahl | Hou and Robinson (2006) |
| Idiosyncratic Risk | Ang, Hodrick, Xing, Zhang (2006) |
| Industry momentum | Grinblatt and Moskowitz (1999) |
| Investment | Titman, Wei, and Xie (2004) |
| IPO | Ritter (1991) |
| IPO no R&D | Gou, Lev, and Shi (2006) |
| Lagged Momentum | Novy-Marx (2012) |
| Leverage | Bhandari (1988) |
| Leverage Component of B/P | Penman, Richardson, and Tuna (2007) |
| Long-term Reversal | Debondt and Thaler (1985) |
| M/B and Accruals | Bartov and Kim (2004) |
| Max | Bali, Cakici, and Whitelaw (2010) |
| Momentum | Jegadeesh and Titman (1993) |
| Momentum and LT reversal | Chan and Kot (2006) |
| Momentum-Reversal | Jegadeesh and Titman (1993) |
| NOA | Hirshleifer, Hou, and Teoh (2004) |
| Operating Leverage | Novy-Marx (2010) |
| Org. Capital | Eisfeldt and Papanikolaou (2013) |
| O-Score | Dichev (1998) |
| Pension Funding | Franzoni and Marin (2006) |

| Signal | Author |
|---|---|
| Percent Operating Accrual | Hafzalla, Lundholm, and Van Winkle (2011) |
| Percent Total Accrual | Hafzalla, Lundholm, and Van Winkle (2011) |
| Post Earnings Drift | Ball and Brown (1968) |
| Price | Blume and Husic (1973) |
| Profit Margin | Soliman (2008) |
| Profitability | Balakrishnan, Bartov, and Faurel (2010) |
| R&D Increases | Eberhart, Maxwell, and Siddique (2004) |
| R&D/MV | Chan, Lakonishok, Sougiannis (2001) |
| Share Repurchases | Ikenberry, Lakonishok, and Vermaelen (1995) |
| Return on Equity | Haugen and Baker (1996) |
| Revenue Surprises | Jegadeesh and Livnat (2006) |
| ROE | Haugen and Baker (1996) |
| Sales Growth | Lakonishok, Shleifer, and Vishny (1994) |
| Sales/Price | Barbee, Mukherji, and Raines (1996) |
| Seasonality | Heston and Sadka (2008) |
| Share Issuance 1-Year | Pontiff and Woodgate (2008) |
| Share Issuance 5-Year | Daniel and Titman (2006) |
| Short-term Reversal | Jegadeesh (1989) |
| Size | Banz (1981) |
| Sustainable Growth | Lockwood and Prombutr (2010) |
| Tax | Lev and Nissim (2004) |
| Total External Finance | Bradshaw, Richardson, and Sloan (2006) |
| Up Forecast | Barber, LeHavy, McNichols, Trueman (2001) |
| Volume | Datar, Naik, and Radcliffe (1998) |
| Volume Trend | Haugen and Baker (1996) |
| Volume Variance | Chordia, Subrahmanyam, and Anshuman (2001) |
| Volume/MV | Haugen and Baker (1996) |
| Volume-Momentum | Lee and Swaminathan (2000) |
| Z-Score | Dichev (1998) |

## Table 2: Number of Significant Factors

This table reports number of significant factors within each region and size division. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| + Significant at 0.10 level | 16 | 32 | 26 | 11 | 15 | 13 |
| + Significant at 0.05 level | 10 | 27 | 20 | 2 | 8 | 5 |
| + Significant at 0.01 level | 2 | 20 | 17 | 0 | 4 | 5 |
| - Significant at 0.10 level | 1 | 4 | 2 | 1 | 1 | 0 |
| - Significant at 0.05 level | 0 | 3 | 2 | 0 | 0 | 0 |
| - Significant at 0.01 level | 0 | 3 | 1 | 0 | 0 | 0 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| + Significant at 0.10 level | 8 | 24 | 21 | 7 | 40 | 27 |
| + Significant at 0.05 level | 6 | 23 | 15 | 4 | 36 | 19 |
| + Significant at 0.01 level | 4 | 17 | 11 | 2 | 26 | 9 |
| - Significant at 0.10 level | 3 | 6 | 4 | 0 | 7 | 0 |
| - Significant at 0.05 level | 1 | 3 | 3 | 0 | 3 | 0 |
| - Significant at 0.01 level | 0 | 2 | 1 | 0 | 0 | 0 |

## Table 3: Factor Returns

This table reports monthly mean percentage returns of large and small factor portfolios. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016). * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 0.18** | 0.15*** | 0.16*** | 0.19* | 0.17** | 0.18*** |
| Change in Profit Margin | 0.04 | 0.08 | 0.06 | -0.08 | 0.03 | -0.03 |
| Chg. Forecast plus Accrual | 0.29 | 0.71*** | 0.5*** | -0.01 | 0.35* | 0.17 |
| Dividend Initiation | -0.15 | -0.28* | -0.21 | -0.10 | -0.25 | -0.17 |
| Dividend Omission | 0.22 | 0.17 | 0.19 | 0.13 | -0.06 | 0.04 |
| Dividends | -0.03 | 0.16 | 0.07 | -0.15 | -0.04 | -0.10 |
| Down Forecast | 0.26** | 0.47*** | 0.37*** | 0.16 | 0.00 | 0.08 |
| Earnings Surprise | 0.11 | 0.2*** | 0.15* | 0.02 | 0.01 | 0.02 |
| Growth in Inventory | 0.05 | 0.14 | 0.10 | 0.08 | 0.00 | 0.04 |
| Growth in LTNOA | 0.07 | 0.09 | 0.08 | 0.20 | 0.22* | 0.21* |
| IPO | -0.08 | 0.19* | 0.05 | -0.12 | 0.19 | 0.04 |
| IPO no R&D | -0.07 | 0.16* | 0.04 | -0.09 | 0.35*** | 0.13 |
| Post Earnings Drift | 0.23 | 0.19* | 0.21 | 0.23 | 0.12 | 0.18 |
| R&D Increases | 0.19 | 0.07 | 0.13 | 0.26 | 0.11 | 0.18 |
| Repurchases | 0.17 | 0.26* | 0.21 | 0.15 | 0.24* | 0.20 |
| Revenue Surprises | 0.17 | 0.27** | 0.22* | 0.03 | 0.11 | 0.07 |
| Share Issuance 1-Year | 0.18 | 0.3*** | 0.24** | 0.29* | 0.27 | 0.28* |
| Share Issuance 5-Year | 0.19* | 0.18 | 0.19* | 0.26** | 0.14 | 0.20 |
| Sustainable Growth | -0.04 | 0.08 | 0.02 | 0.21 | 0.23** | 0.22* |
| Total External Finance | 0.21* | 0.37*** | 0.29*** | 0.08 | 0.14 | 0.11 |
| Up Forecast | 0.25** | 0.51*** | 0.38*** | 0.14 | 0.07 | 0.10 |
| ΔCapex - ΔIndustry Capex | 0.06 | 0.13 | 0.10 | 0.03 | 0.07 | 0.05 |
| ΔNoncurrent Op. Assets | 0.12 | -0.07 | 0.02 | 0.31* | 0.02 | 0.16 |
| ΔSales - ΔInventory | 0.09 | 0.09 | 0.09 | -0.01 | 0.13 | 0.06 |
| ΔSales - ΔSG&A | 0.03 | 0.07 | 0.05 | -0.05 | 0.11 | 0.03 |
| ΔWork. capital | -0.08 | 0.06 | -0.01 | 0.05 | 0.10 | 0.07 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 0.07 | 0.06 | 0.06 | 0.37 | 0.19* | 0.28** |
| Change in Profit Margin | 0.12 | 0.08 | 0.10 | -0.02 | 0.02 | 0.00 |
| Chg. Forecast plus Accrual | 0.07 | 0.51*** | 0.29** | 0.7*** | 1.34*** | 1.02*** |
| Dividend Initiation | -0.14 | 0.02 | -0.06 | -0.18 | 0.31 | 0.07 |
| Dividend Omission | 0.29 | 0.17 | 0.23 | 0.16 | -0.33 | -0.08 |
| Dividends | 0.14 | 0.22 | 0.18 | 0.16 | 0.47*** | 0.31* |
| Down Forecast | 0.17 | 0.43*** | 0.3*** | 0.34 | 0.86*** | 0.6*** |
| Earnings Surprise | 0.10 | 0.24*** | 0.17* | 0.16 | 0.21 | 0.18 |
| Growth in Inventory | 0.03 | 0.23** | 0.13 | -0.11 | 0.27** | 0.08 |
| Growth in LTNOA | -0.01 | 0.03 | 0.01 | 0.28 | 0.35*** | 0.32* |
| IPO | -0.01 | 0.18 | 0.08 | 0.26 | 0.29** | 0.27 |
| IPO no R&D | -0.12 | 0.31*** | 0.09 | 0.05 | 0.23 | 0.14 |
| Post Earnings Drift | 0.09 | 0.32** | 0.20 | 0.33* | 0.26 | 0.3** |
| R&D Increases | 0.15 | 0.13 | 0.14 | 0.26 | 0.71*** | 0.49** |
| Repurchases | 0.03 | 0.24 | 0.14 | -0.09 | 0.06 | -0.01 |
| Revenue Surprises | 0.12 | 0.33** | 0.23 | 0.18 | -0.25 | -0.03 |
| Share Issuance 1-Year | 0.11 | 0.15 | 0.13 | -0.05 | 0.59*** | 0.27 |
| Share Issuance 5-Year | 0.07 | 0.02 | 0.04 | -0.10 | 0.71*** | 0.31 |
| Sustainable Growth | -0.14 | 0.02 | -0.06 | -0.10 | 0.27 | 0.09 |
| Total External Finance | 0.13 | 0.44*** | 0.29*** | 0.16 | 0.46*** | 0.31* |
| Up Forecast | 0.16 | 0.42*** | 0.29*** | 0.39* | 0.84*** | 0.61*** |
| ΔCapex - ΔIndustry Capex | -0.18 | -0.01 | -0.09 | -0.03 | 0.35*** | 0.16 |
| ΔNoncurrent Op. Assets | -0.01 | -0.10 | -0.06 | 0.27 | -0.11 | 0.08 |
| ΔSales - ΔInventory | 0.00 | -0.03 | -0.02 | -0.15 | -0.34** | -0.25 |
| ΔSales - ΔSG&A | 0.04 | 0.00 | 0.02 | -0.10 | -0.38** | -0.24 |
| ΔWork. capital | -0.07 | 0.06 | -0.01 | -0.25 | 0.21 | -0.02 |

Panel B: Market Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 0.22 | 0.63** | 0.42 | -0.05 | -0.01 | -0.03 |
| Age-Momentum | 0.34 | 0.16 | 0.25 | 0.61* | 0.18 | 0.40 |
| Amihud's Measure | 0.09 | -0.07 | 0.01 | 0.04 | -0.01 | 0.02 |
| Beta | 0.33 | 0.08 | 0.20 | -0.04 | 0.00 | -0.02 |
| Bid/Ask Spread | -0.23* | -0.36*** | -0.3*** | -0.03 | 0.27 | 0.12 |
| CoSkewness | 0.2** | 0.11 | 0.15** | 0.07 | 0.15 | 0.11 |
| Idiosyncratic Risk | 0.29 | 0.17 | 0.23 | 0.26 | 0.07 | 0.17 |
| Industry momentum | 0.44** | 0.52*** | 0.48*** | 0.23 | 0.48* | 0.36 |
| Lagged Momentum | 0.29 | 0.12 | 0.20 | 0.29 | -0.02 | 0.14 |
| Long-term Reversal | -0.09 | 0.06 | -0.01 | 0.03 | 0.12 | 0.07 |
| Max | 0.27 | 0.18 | 0.23 | 0.36 | 0.27 | 0.32 |
| Momentum | 0.19 | 0.62** | 0.40 | -0.04 | -0.03 | -0.03 |
| Momentum and LT reversal | 0.15 | 0.26 | 0.21 | -0.01 | -0.11 | -0.06 |
| Momentum-Reversal | 0.11 | 0.39*** | 0.25 | 0.15 | 0.29 | 0.22 |
| Price | -0.13 | -0.16 | -0.15 | 0.03 | 0.26 | 0.14 |
| Seasonality | -0.15 | 0.04 | -0.06 | -0.19* | -0.02 | -0.11 |
| Short-term Reversal | 0.21 | -0.32 | -0.06 | 0.39* | 0.32 | 0.36 |
| Size | 0.10 | 0.01 | 0.05 | 0.10 | 0.21** | 0.15* |
| Volume | -0.21 | 0.09 | -0.06 | -0.23 | 0.02 | -0.11 |
| Volume Trend | -0.09 | -0.15 | -0.12 | 0.13 | 0.09 | 0.11 |
| Volume Variance | 0.10 | 0.22 | 0.16 | 0.15 | 0.01 | 0.08 |
| Volume-Momentum | 0.22 | -0.11 | 0.05 | 0.06 | -0.12 | -0.03 |
| Volume/MV | -0.21 | 0.10 | -0.05 | -0.23 | -0.02 | -0.12 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 0.36 | 0.82*** | 0.59** | -0.21 | 0.76*** | 0.28 |
| Age-Momentum | 0.09 | 0.07 | 0.08 | 0.16 | 0.09 | 0.12 |
| Amihud's Measure | 0.14 | 0.01 | 0.07 | 0.50 | 0.20 | 0.35 |
| Beta | 0.48* | 0.33 | 0.41 | 0.00 | -0.12 | -0.06 |
| Bid/Ask Spread | -0.12 | -0.37*** | -0.25*** | -0.24 | -0.39* | -0.31 |
| CoSkewness | 0.2** | 0.15** | 0.18*** | 0.54** | 0.04 | 0.29** |
| Idiosyncratic Risk | 0.34 | 0.38* | 0.36* | 0.02 | -0.09 | -0.03 |
| Industry momentum | 0.35 | 0.5*** | 0.43*** | -0.01 | 0.28* | 0.14 |
| Lagged Momentum | 0.26 | 0.29 | 0.27 | 0.28 | 0.23 | 0.26 |
| Long-term Reversal | -0.12 | 0.00 | -0.06 | 0.66*** | 0.68*** | 0.67*** |
| Max | 0.36 | 0.29 | 0.32 | 0.18 | 0.10 | 0.14 |
| Momentum | 0.22 | 0.75*** | 0.48* | -0.01 | 0.62** | 0.30 |
| Momentum and LT reversal | 0.25 | 0.33 | 0.29 | -0.26 | 0.22 | -0.02 |
| Momentum-Reversal | 0.12 | 0.27 | 0.20 | 0.49 | 0.56*** | 0.53** |
| Price | -0.08 | -0.11 | -0.09 | -0.05 | -0.25 | -0.15 |
| Seasonality | 0.04 | 0.20 | 0.12 | -0.03 | -0.20 | -0.11 |
| Short-term Reversal | 0.13 | -0.38* | -0.13 | 0.51 | -0.53** | -0.01 |
| Size | 0.14 | 0.01 | 0.08 | 0.07 | -0.09 | -0.01 |
| Volume | 0.00 | 0.15 | 0.07 | 0.24 | 0.47* | 0.35 |
| Volume Trend | -0.05 | -0.17 | -0.11 | 0.09 | -0.09 | 0.00 |
| Volume Variance | 0.18 | 0.22 | 0.2* | 0.41 | 0.58** | 0.49* |
| Volume-Momentum | 0.04 | -0.17 | -0.06 | 0.06 | -0.12 | -0.03 |
| Volume/MV | -0.05 | 0.15 | 0.05 | 0.29 | 0.38 | 0.34 |

Panel C: Valuation Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 0.12 | 0.09 | 0.10 | 0.37* | 0.36 | 0.37* |
| Book-to-Market | 0.08 | 0.22 | 0.15 | 0.02 | 0.16 | 0.09 |
| Cash Flow/MV | 0.32** | 0.65*** | 0.49*** | 0.16 | 0.35 | 0.25 |
| Dividend Yield | 0.20 | 0.29 | 0.24 | -0.06 | -0.03 | -0.04 |
| Earnings-to-Price | 0.36** | 0.57*** | 0.47*** | 0.24 | 0.23 | 0.24 |
| Enterprise Component of B/P | 0.07 | 0.14 | 0.10 | 0.22 | 0.19 | 0.21* |
| Enterprise Multiple | 0.41*** | 0.67*** | 0.54*** | 0.36* | 0.4* | 0.38* |
| Leverage Component of B/P | 0.11 | 0.00 | 0.06 | 0.34 | 0.05 | 0.19 |
| Org. Capital | 0.10 | 0.10 | 0.10 | 0.16 | 0.08 | 0.12 |
| R&D/MV | 0.06 | 0.02 | 0.04 | 0.19 | 0.19 | 0.19 |
| Sales/Price | 0.17 | 0.36** | 0.27* | 0.26 | 0.34 | 0.30 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | -0.09 | 0.02 | -0.04 | 0.16 | -0.01 | 0.07 |
| Book-to-Market | 0.20 | 0.23 | 0.21 | 0.37 | 0.49*** | 0.43** |
| Cash Flow/MV | 0.34*** | 0.64*** | 0.49*** | 0.54* | 0.66*** | 0.6*** |
| Dividend Yield | 0.41*** | 0.59*** | 0.5*** | 0.28 | 0.58*** | 0.43** |
| Earnings-to-Price | 0.44*** | 0.66*** | 0.55*** | 0.38 | 0.57*** | 0.48*** |
| Enterprise Component of B/P | 0.08 | 0.10 | 0.09 | 0.22 | 0.36** | 0.29* |
| Enterprise Multiple | 0.31*** | 0.48*** | 0.39*** | 0.29 | 0.66*** | 0.48*** |
| Leverage Component of B/P | 0.02 | 0.01 | 0.02 | 0.12 | 0.04 | 0.08 |
| Org. Capital | -0.05 | -0.11 | -0.08 | 0.26 | 0.48*** | 0.37** |
| R&D/MV | -0.03 | 0.03 | 0.00 | 0.03 | 0.00 | 0.02 |
| Sales/Price | 0.19 | 0.21 | 0.20 | 0.41 | 0.8*** | 0.61*** |

Panel D: Fundamental Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 0.09 | 0.28*** | 0.19** | 0.16 | 0.16 | 0.16 |
| Age | -0.03 | -0.29*** | -0.16 | 0.16 | -0.27 | -0.05 |
| Asset Growth | 0.02 | 0.18 | 0.10 | 0.15 | 0.2* | 0.17 |
| Asset Turnover | 0.25** | 0.17** | 0.21*** | 0.27* | 0.20 | 0.23* |
| Cash Flow Variance | -0.10 | -0.43*** | -0.27** | -0.07 | -0.31* | -0.19 |
| Earnings Consistency | -0.02 | 0.05 | 0.02 | -0.28 | 0.23 | -0.03 |
| Forecast Dispersion | 0.23 | 0.21 | 0.22 | 0.15 | -0.06 | 0.04 |
| Gross Profitability | 0.3* | 0.26** | 0.28*** | 0.22 | 0.22 | 0.22 |
| G-Score | 0.04 | 0.57*** | 0.43*** | 0.22 | 0.56** | 0.54*** |
| F-Score | 0.17* | 0.29*** | 0.23*** | 0.14 | 0.06 | 0.10 |
| Herfindahl | -0.07 | -0.25 | -0.16 | 0.04 | -0.17 | -0.06 |
| Investment | 0.06 | 0.14** | 0.10 | 0.02 | 0.15* | 0.08 |
| Leverage | 0.16 | 0.08 | 0.12* | 0.21 | 0.3*** | 0.25*** |
| M/B and Accruals | 0.05 | 0.63*** | 0.34*** | 0.43* | 0.66*** | 0.54*** |
| NOA | 0.17 | 0.02 | 0.10 | 0.34** | 0.06 | 0.20 |
| Operating Leverage | 0.11 | 0.10 | 0.11 | 0.17 | 0.10 | 0.13 |
| O-Score | -0.06 | 0.15* | 0.05 | -0.26 | 0.02 | -0.12 |
| Pension Funding | -0.02 | 0.16 | 0.07 | -0.05 | -0.04 | -0.04 |
| Percent Operating Accrual | 0.17* | 0.29*** | 0.23*** | 0.14 | 0.25*** | 0.2*** |
| Percent Total Accrual | -0.07 | 0.2*** | 0.07 | 0.05 | 0.13 | 0.09 |
| Profit Margin | 0.16 | 0.19 | 0.18* | -0.08 | 0.00 | -0.04 |
| Profitability | 0.28* | 0.36*** | 0.32*** | 0.15 | 0.00 | 0.07 |
| ROE | 0.38*** | 0.4*** | 0.39*** | 0.16 | 0.08 | 0.12 |
| Sales Growth | 0.06 | 0.05 | 0.06 | -0.01 | 0.14 | 0.07 |
| Tax | -0.08 | -0.14 | -0.11 | 0.06 | 0.05 | 0.06 |
| Z-Score | 0.09 | -0.10 | -0.01 | 0.00 | -0.19 | -0.10 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | -0.04 | 0.28*** | 0.12 | -0.29 | 0.41*** | 0.06 |
| Age | -0.08 | -0.28*** | -0.18 | -0.35 | -0.20 | -0.28 |
| Asset Growth | 0.04 | 0.22 | 0.13 | 0.04 | 0.46*** | 0.25 |
| Asset Turnover | 0.09 | 0.05 | 0.07 | 0.6** | 0.35*** | 0.48*** |
| Cash Flow Variance | -0.05 | -0.25* | -0.15 | -0.15 | -0.37* | -0.26 |
| Earnings Consistency | -0.42** | -0.05 | -0.23* | -0.01 | 0.16 | 0.08 |
| Forecast Dispersion | 0.16 | 0.16 | 0.16 | -0.10 | 0.22 | 0.06 |
| Gross Profitability | 0.17 | 0.13 | 0.15 | 0.26 | 0.33* | 0.29* |
| G-Score | -0.09 | 0.37 | 0.25 | -0.05 | 0.73** | 0.34 |
| F-Score | 0.13 | 0.27*** | 0.2** | 0.14 | 0.37*** | 0.26* |
| Herfindahl | -0.32* | -0.56** | -0.44** | -0.16 | -0.44* | -0.30 |
| Investment | 0.13 | 0.11 | 0.12* | 0.03 | 0.2** | 0.12 |
| Leverage | 0.15 | 0.07 | 0.11 | 0.14 | -0.11 | 0.02 |
| M/B and Accruals | 0.37 | 0.20 | 0.28* | -0.39 | 0.62** | 0.12 |
| NOA | 0.07 | -0.05 | 0.01 | 0.32 | 0.05 | 0.18 |
| Operating Leverage | 0.07 | 0.11 | 0.09 | 0.32 | 0.3** | 0.31** |
| O-Score | 0.03 | 0.22** | 0.12 | 0.00 | 0.17 | 0.09 |
| Pension Funding | 0.08 | 0.11 | 0.12 | 0.15 | 0.42 | 0.28 |
| Percent Operating Accrual | -0.10 | 0.08 | -0.01 | 0.22 | 0.42*** | 0.32* |
| Percent Total Accrual | -0.17 | 0.16 | -0.01 | -0.21 | 0.43*** | 0.11 |
| Profit Margin | 0.21 | 0.31** | 0.26** | 0.02 | -0.07 | -0.02 |
| Profitability | 0.34* | 0.53*** | 0.43*** | 0.29 | 0.39** | 0.34** |
| ROE | 0.38** | 0.45*** | 0.41*** | 0.22 | 0.20 | 0.21 |
| Sales Growth | -0.03 | -0.02 | -0.03 | -0.06 | -0.45* | -0.26 |
| Tax | -0.23* | -0.33* | -0.28** | 0.09 | 0.15 | 0.12 |
| Z-Score | 0.09 | -0.08 | 0.01 | 0.19 | -0.06 | 0.07 |

Table 4: Equal-Weighted Factor Portfolio Returns

This table reports monthly mean returns of equal-weighted portfolios of factors. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | 0.11 | 0.16 | 0.14 | 0.11 | 0.12 | 0.11 |
| Volatility | 0.59 | 0.62 | 0.57 | 0.74 | 0.82 | 0.73 |
| Sharpe Ratio | 0.19 | 0.26 | 0.24 | 0.14 | 0.14 | 0.15 |
| t-stat | 3.14 | 4.44 | 4.07 | 2.40 | 2.41 | 2.60 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | 0.09 | 0.15 | 0.12 | 0.13 | 0.23 | 0.18 |
| Volatility | 0.60 | 0.61 | 0.57 | 0.73 | 0.71 | 0.63 |
| Sharpe Ratio | 0.14 | 0.25 | 0.21 | 0.17 | 0.33 | 0.28 |
| t-stat | 2.37 | 4.23 | 3.56 | 2.90 | 5.58 | 4.79 |

## Table 5: Equal-Weighted Factor Portfolio Alphas

This table reports monthly alphas and betas of equal-weighted portfolios of factors against the corresponding U.S. portfolios matched by size. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all 87 calculable factors from using McLean and Pontiff (2016).

| | Global | | | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average | Large | Small | Average |
| Alpha | 0.04 | 0.09 | 0.06 | 0.02 | 0.09 | 0.05 | 0.09 | 0.20 | 0.14 |
| Alpha t-stat | 2.14 | 4.62 | 3.86 | 0.88 | 3.50 | 2.41 | 2.11 | 4.98 | 3.99 |
| Beta | 0.70 | 0.65 | 0.70 | 0.60 | 0.52 | 0.61 | 0.39 | 0.33 | 0.39 |
| Beta t-stat | 30.93 | 28.68 | 33.58 | 18.00 | 16.25 | 20.97 | 7.10 | 6.95 | 8.50 |
| R-squared | 77% | 75% | 80% | 54% | 49% | 61% | 15% | 15% | 21% |

## Table 6: Post-Sample Equal-Weighted Factor Portfolio Returns

This table reports monthly mean returns of equal-weighted portfolios of factors post-sample where post-sample. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated from the later of July 1995 or the January after the initial paper's sample periods end to December 2018. Sample periods can be found in the online appendix of McLean and Pontiff (2016). Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | 0.10 | 0.15 | 0.13 | 0.10 | 0.12 | 0.11 |
| Volatility | 0.57 | 0.60 | 0.55 | 0.72 | 0.77 | 0.70 |
| Sharpe Ratio | 0.18 | 0.25 | 0.23 | 0.13 | 0.15 | 0.15 |
| t-stat | 3.08 | 4.15 | 3.87 | 2.26 | 2.52 | 2.56 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | 0.10 | 0.16 | 0.13 | 0.12 | 0.22 | 0.17 |
| Volatility | 0.61 | 0.64 | 0.58 | 0.78 | 0.72 | 0.66 |
| Sharpe Ratio | 0.16 | 0.25 | 0.22 | 0.16 | 0.30 | 0.26 |
| t-stat | 2.66 | 4.17 | 3.65 | 2.67 | 5.07 | 4.33 |

## Table 7: Covariance Factor Returns

This table reports mean returns of large and small factor portfolios based on full period factor loadings as opposed to characteristics. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016). * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 0.16 | 0.32 | 0.24 | -0.08 | 0.05 | -0.02 |
| Change in Profit Margin | 0.23 | 0.28 | 0.26 | 0.33 | 0.24 | 0.29 |
| Chg. Forecast plus Accrual | 0.18 | 0.10 | 0.14 | 0.20 | 0.23 | 0.22 |
| Dividend Initiation | -0.36* | -0.49** | -0.42** | -0.20 | -0.08 | -0.14 |
| Dividend Omission | 0.28 | 0.31 | 0.30 | 0.22 | 0.21 | 0.22 |
| Dividends | -0.12 | 0.03 | -0.04 | -0.20 | -0.10 | -0.15 |
| Down Forecast | 0.26 | 0.13 | 0.20 | 0.34 | 0.34 | 0.34 |
| Earnings Surprise | 0.45*** | 0.53*** | 0.49*** | 0.46*** | 0.48** | 0.47*** |
| Growth in Inventory | -0.29 | -0.33 | -0.31 | -0.16 | -0.31 | -0.24 |
| Growth in LTNOA | -0.26 | -0.25 | -0.25 | -0.15 | -0.20 | -0.18 |
| IPO | 0.06 | 0.28 | 0.17 | -0.18 | 0.07 | -0.05 |
| IPO no R&D | 0.13 | 0.09 | 0.11 | 0.26 | 0.19 | 0.23 |
| Post Earnings Drift | 0.13 | -0.02 | 0.05 | 0.22 | 0.22 | 0.22 |
| R&D Increases | -0.15 | -0.12 | -0.13 | -0.13 | 0.04 | -0.05 |
| Repurchases | 0.06 | 0.12 | 0.09 | -0.13 | -0.13 | -0.13 |
| Revenue Surprises | 0.44* | 0.48* | 0.46** | 0.37 | 0.51 | 0.44 |
| Share Issuance 1-Year | -0.10 | -0.01 | -0.05 | -0.16 | -0.10 | -0.13 |
| Share Issuance 5-Year | -0.10 | -0.12 | -0.11 | -0.05 | -0.02 | -0.04 |
| Sustainable Growth | -0.31 | -0.32 | -0.32 | -0.30 | -0.22 | -0.26 |
| Total External Finance | 0.01 | 0.08 | 0.04 | -0.18 | -0.03 | -0.11 |
| Up Forecast | 0.21 | 0.08 | 0.14 | 0.31 | 0.35 | 0.33 |
| ΔCapex - ΔIndustry Capex | -0.06 | 0.01 | -0.02 | -0.18 | -0.11 | -0.15 |
| ΔNoncurrent Op. Assets | 0.01 | -0.18 | -0.08 | 0.23 | -0.02 | 0.10 |
| ΔSales - ΔInventory | 0.33 | 0.39 | 0.36 | 0.23 | 0.30 | 0.26 |
| ΔSales - ΔSG&A | 0.32 | 0.39 | 0.35 | 0.27 | 0.32 | 0.30 |
| ΔWork. capital | -0.27 | -0.25 | -0.26 | -0.24 | -0.12 | -0.18 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 0.23 | 0.24 | 0.24 | 0.43 | 0.21 | 0.32 |
| Change in Profit Margin | 0.43*** | 0.45* | 0.44** | 0.43 | 0.42 | 0.42* |
| Chg. Forecast plus Accrual | 0.15 | -0.13 | 0.01 | -0.32 | -0.22 | -0.27 |
| Dividend Initiation | -0.44* | -0.53 | -0.48* | -0.40 | -0.22 | -0.31 |
| Dividend Omission | 0.44 | 0.47 | 0.46 | -0.27 | -0.43 | -0.35 |
| Dividends | 0.26 | 0.36 | 0.31 | 0.40 | 0.73** | 0.56* |
| Down Forecast | 0.05 | -0.17 | -0.06 | 0.22 | 0.08 | 0.15 |
| Earnings Surprise | 0.48*** | 0.60** | 0.54*** | 0.54 | 0.06 | 0.30 |
| Growth in Inventory | -0.50* | -0.49 | -0.50* | -0.45 | -0.06 | -0.26 |
| Growth in LTNOA | -0.42 | -0.49 | -0.46 | 0.06 | 0.42 | 0.24 |
| IPO | 0.25 | 0.40 | 0.33 | -0.11 | 0.09 | -0.01 |
| IPO no R&D | 0.42* | 0.32 | 0.37* | -0.15 | 0.00 | -0.07 |
| Post Earnings Drift | 0.12 | 0.14 | 0.13 | 0.30 | 0.06 | 0.18 |
| R&D Increases | -0.08 | -0.11 | -0.09 | -0.15 | 0.05 | -0.05 |
| Repurchases | -0.22 | -0.20 | -0.21 | -0.22 | -0.11 | -0.16 |
| Revenue Surprises | 0.44* | 0.50* | 0.47* | 0.49 | -0.23 | 0.13 |
| Share Issuance 1-Year | -0.40 | -0.34 | -0.37 | 0.55 | 0.51 | 0.53 |
| Share Issuance 5-Year | -0.41 | -0.35 | -0.38 | 0.41 | 0.36 | 0.39 |
| Sustainable Growth | -0.52* | -0.53 | -0.52* | -0.06 | 0.36 | 0.15 |
| Total External Finance | -0.12 | -0.12 | -0.12 | 0.27 | 0.55* | 0.41 |
| Up Forecast | 0.05 | -0.20 | -0.08 | 0.29 | 0.09 | 0.19 |
| ΔCapex - ΔIndustry Capex | 0.11 | 0.06 | 0.08 | -0.26 | -0.03 | -0.15 |
| ΔNoncurrent Op. Assets | -0.25 | -0.33 | -0.29 | -0.19 | 0.05 | -0.07 |
| ΔSales - ΔInventory | 0.51* | 0.53 | 0.52 | 0.43 | -0.10 | 0.16 |
| ΔSales - ΔSG&A | 0.48* | 0.53 | 0.51 | 0.28 | -0.09 | 0.09 |
| ΔWork. capital | -0.32 | -0.36 | -0.34 | 0.14 | 0.18 | 0.16 |

Panel B: Market Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 0.41* | 0.49** | 0.45** | 0.23 | 0.39 | 0.31 |
| Age-Momentum | 0.20 | 0.10 | 0.15 | 0.27 | 0.48 | 0.37 |
| Amihud's Measure | -0.25 | -0.32 | -0.29 | -0.24 | -0.34 | -0.29 |
| Beta | 0.05 | 0.21 | 0.13 | -0.14 | 0.06 | -0.04 |
| Bid/Ask Spread | -0.24 | -0.20 | -0.22 | -0.36* | -0.29 | -0.32 |
| CoSkewness | -0.01 | -0.07 | -0.04 | 0.10 | 0.15 | 0.13 |
| Idiosyncratic Risk | 0.08 | 0.23 | 0.16 | -0.12 | 0.10 | -0.01 |
| Industry momentum | 0.18 | 0.22 | 0.20 | 0.19 | 0.31 | 0.25 |
| Lagged Momentum | 0.27 | 0.36 | 0.31 | 0.18 | 0.25 | 0.22 |
| Long-term Reversal | -0.39* | -0.46* | -0.42* | -0.35 | -0.42 | -0.38 |
| Max | 0.04 | 0.15 | 0.10 | -0.13 | 0.08 | -0.02 |
| Momentum | 0.32 | 0.39* | 0.35* | 0.32 | 0.30 | 0.31 |
| Momentum and LT reversal | 0.22* | 0.18 | 0.20 | 0.10 | 0.05 | 0.07 |
| Momentum-Reversal | -0.20 | -0.11 | -0.15 | -0.27 | -0.24 | -0.25 |
| Price | -0.34 | -0.44 | -0.39 | -0.38* | -0.46 | -0.42* |
| Seasonality | 0.23 | 0.36 | 0.29 | 0.00 | 0.05 | 0.02 |
| Short-term Reversal | -0.16 | -0.28 | -0.22 | -0.04 | -0.29 | -0.16 |
| Size | -0.19 | -0.29 | -0.24 | -0.33 | -0.48 | -0.41 |
| Volume | -0.20 | -0.16 | -0.18 | -0.18 | -0.02 | -0.10 |
| Volume Trend | -0.42* | -0.52* | -0.47* | -0.30 | -0.45 | -0.37 |
| Volume Variance | -0.17 | -0.09 | -0.13 | -0.11 | -0.09 | -0.10 |
| Volume-Momentum | 0.24 | 0.22 | 0.23 | 0.22 | 0.47 | 0.34 |
| Volume/MV | -0.19 | -0.16 | -0.17 | -0.16 | 0.05 | -0.06 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 0.44** | 0.57*** | 0.50*** | 0.55* | 0.45* | 0.50** |
| Age-Momentum | 0.21 | 0.21 | 0.21 | 0.52* | 0.21 | 0.36 |
| Amihud's Measure | -0.31 | -0.48* | -0.40 | 0.27 | 0.30 | 0.28 |
| Beta | 0.21 | 0.47* | 0.34 | 0.25 | 0.12 | 0.18 |
| Bid/Ask Spread | -0.43 | -0.50* | -0.46* | 0.29 | 0.24 | 0.26 |
| CoSkewness | 0.00 | -0.09 | -0.05 | 0.22 | 0.00 | 0.11 |
| Idiosyncratic Risk | 0.33 | 0.51* | 0.42 | 0.48 | -0.19 | 0.14 |
| Industry momentum | 0.12 | 0.18 | 0.15 | 0.35 | 0.33 | 0.34 |
| Lagged Momentum | 0.46*** | 0.50** | 0.48** | 0.57** | 0.29 | 0.43** |
| Long-term Reversal | -0.49* | -0.64* | -0.57* | -0.46 | -0.12 | -0.29 |
| Max | 0.25 | 0.34 | 0.29 | 0.42 | -0.13 | 0.14 |
| Momentum | 0.34 | 0.45* | 0.39* | 0.49** | 0.58*** | 0.54*** |
| Momentum and LT reversal | 0.07 | 0.00 | 0.04 | 0.35 | 0.38 | 0.37 |
| Momentum-Reversal | -0.29 | -0.44* | -0.36** | -0.14 | -0.30 | -0.22 |
| Price | -0.40 | -0.52* | -0.46* | -0.23 | -0.53 | -0.38 |
| Seasonality | 0.53* | 0.52 | 0.53 | -0.15 | 0.12 | -0.02 |
| Short-term Reversal | -0.14 | -0.37 | -0.25 | 0.04 | -0.09 | -0.03 |
| Size | -0.49* | -0.68*** | -0.59** | -0.40 | -0.15 | -0.27 |
| Volume | -0.17 | -0.29 | -0.23 | 0.25 | 0.30 | 0.27 |
| Volume Trend | -0.40 | -0.59* | -0.50* | -0.37 | -0.53* | -0.45 |
| Volume Variance | -0.20 | -0.24 | -0.22 | 0.20 | 0.29 | 0.25 |
| Volume-Momentum | 0.45** | 0.49* | 0.47** | 0.38 | 0.25 | 0.32 |
| Volume/MV | -0.16 | -0.28 | -0.22 | 0.38 | 0.30 | 0.34 |

Panel C: Valuation Anomalies

| | | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 0.17 | 0.08 | 0.12 | 0.20 | 0.13 | 0.16 |
| Book-to-Market | -0.32 | -0.29 | -0.31 | -0.22 | -0.30 | -0.26 |
| Cash Flow/MV | -0.07 | 0.09 | 0.01 | -0.21 | -0.15 | -0.18 |
| Dividend Yield | -0.10 | 0.07 | -0.01 | -0.19 | -0.14 | -0.16 |
| Earnings-to-Price | 0.07 | 0.22 | 0.14 | -0.18 | -0.13 | -0.15 |
| Enterprise Component of B/P | -0.37 | -0.37 | -0.37 | -0.22 | -0.46 | -0.34 |
| Enterprise Multiple | 0.06 | 0.22 | 0.14 | -0.14 | -0.15 | -0.14 |
| Leverage Component of B/P | 0.03 | -0.09 | -0.03 | 0.26 | 0.11 | 0.19 |
| Org. Capital | -0.09 | -0.17 | -0.13 | 0.17 | 0.08 | 0.13 |
| R&D/MV | -0.04 | -0.22 | -0.13 | 0.22 | 0.13 | 0.17 |
| Sales/Price | -0.30 | -0.23 | -0.27 | -0.15 | -0.18 | -0.17 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | -0.09 | -0.23 | -0.16 | 0.41 | 0.22 | 0.31 |
| Book-to-Market | -0.42 | -0.46 | -0.44 | 0.23 | 0.31 | 0.27 |
| Cash Flow/MV | 0.26 | 0.37 | 0.32 | 0.21 | 0.63* | 0.42 |
| Dividend Yield | 0.38 | 0.52 | 0.45 | 0.16 | 0.52 | 0.34 |
| Earnings-to-Price | 0.45 | 0.53 | 0.49 | 0.38 | 0.64** | 0.51 |
| Enterprise Component of B/P | -0.44 | -0.49 | -0.46 | 0.25 | 0.28 | 0.27 |
| Enterprise Multiple | 0.28 | 0.41 | 0.34 | -0.33 | -0.03 | -0.18 |
| Leverage Component of B/P | -0.35 | -0.43 | -0.39 | 0.25 | -0.02 | 0.12 |
| Org. Capital | -0.50* | -0.52 | -0.51* | 0.39 | 0.52 | 0.46 |
| R&D/MV | -0.43 | -0.44 | -0.44 | -0.33 | -0.35 | -0.34 |
| Sales/Price | -0.35 | -0.42 | -0.39 | 0.21 | 0.52 | 0.36 |

Panel D: Fundamental Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 0.01 | -0.09 | -0.04 | 0.15 | 0.07 | 0.11 |
| Age | -0.03 | -0.14 | -0.08 | 0.12 | 0.01 | 0.07 |
| Asset Growth | -0.34 | -0.30 | -0.32 | -0.29 | -0.28 | -0.29 |
| Asset Turnover | 0.14 | 0.02 | 0.08 | 0.27 | 0.26 | 0.26 |
| Cash Flow Variance | 0.11 | 0.03 | 0.07 | 0.21 | 0.29 | 0.25 |
| Earnings Consistency | -0.34 | -0.25 | -0.29 | -0.15 | -0.03 | -0.09 |
| Forecast Dispersion | 0.32 | 0.44 | 0.38 | -0.02 | 0.11 | 0.05 |
| Gross Profitability | 0.27 | 0.31 | 0.29 | 0.26 | 0.28 | 0.27 |
| G-Score | 0.01 | 0.14 | 0.07 | -0.21 | 0.05 | -0.08 |
| F-Score | -0.03 | -0.06 | -0.04 | -0.04 | -0.01 | -0.03 |
| Herfindahl | -0.07 | -0.06 | -0.07 | -0.14 | -0.21 | -0.18 |
| Investment | 0.05 | 0.00 | 0.02 | 0.06 | -0.20 | -0.07 |
| Leverage | -0.27 | -0.31 | -0.29* | -0.36* | -0.54** | -0.45** |
| M/B and Accruals | -0.02 | -0.04 | -0.03 | -0.23 | -0.27 | -0.25 |
| NOA | 0.05 | -0.17 | -0.06 | 0.18 | 0.07 | 0.13 |
| Operating Leverage | 0.14 | 0.05 | 0.09 | 0.18 | 0.19 | 0.18 |
| O-Score | 0.24 | 0.23 | 0.24 | 0.15 | 0.14 | 0.15 |
| Pension Funding | 0.04 | 0.18 | 0.11 | -0.11 | -0.11 | -0.11 |
| Percent Operating Accrual | 0.03 | 0.19 | 0.11 | -0.13 | -0.16 | -0.15 |
| Percent Total Accrual | -0.26 | -0.38 | -0.32 | -0.09 | 0.01 | -0.04 |
| Profit Margin | 0.27 | 0.44 | 0.35 | -0.06 | 0.01 | -0.03 |
| Profitability | 0.43** | 0.57*** | 0.50*** | 0.26 | 0.48** | 0.37* |
| ROE | 0.47** | 0.55** | 0.51** | 0.18 | 0.21 | 0.19 |
| Sales Growth | 0.32 | 0.39 | 0.36 | 0.24 | 0.29 | 0.26 |
| Tax | -0.22 | -0.28 | -0.25 | -0.03 | -0.16 | -0.10 |
| Z-Score | 0.23 | 0.19 | 0.21 | 0.18 | 0.22 | 0.20 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | -0.08 | -0.12 | -0.10 | -0.39 | -0.01 | -0.20 |
| Age | -0.29 | -0.41 | -0.35 | 0.29 | -0.04 | 0.12 |
| Asset Growth | -0.52* | -0.50 | -0.51 | -0.02 | 0.39 | 0.18 |
| Asset Turnover | -0.08 | -0.12 | -0.10 | 0.44 | 0.48 | 0.46 |
| Cash Flow Variance | 0.01 | -0.07 | -0.03 | 0.42 | 0.21 | 0.31 |
| Earnings Consistency | -0.50** | -0.64** | -0.57*** | -0.52 | -0.28 | -0.40 |
| Forecast Dispersion | 0.26 | 0.33 | 0.29 | 0.03 | -0.08 | -0.03 |
| Gross Profitability | 0.14 | 0.28 | 0.21 | 0.49 | 0.49 | 0.49 |
| G-Score | 0.23 | 0.23 | 0.23 | -0.04 | -0.09 | -0.07 |
| F-Score | -0.07 | -0.06 | -0.07 | 0.28 | 0.06 | 0.17 |
| Herfindahl | -0.46 | -0.56 | -0.51 | -0.24 | -0.48 | -0.36 |
| Investment | 0.34 | 0.41 | 0.37 | -0.15 | 0.01 | -0.07 |
| Leverage | -0.49* | -0.66** | -0.57** | -0.72*** | -0.22 | -0.47* |
| M/B and Accruals | 0.05 | 0.02 | 0.04 | 0.36 | 0.36 | 0.36 |
| NOA | -0.15 | -0.23 | -0.19 | 0.02 | 0.14 | 0.08 |
| Operating Leverage | -0.04 | -0.15 | -0.09 | 0.32 | 0.43 | 0.38 |
| O-Score | 0.35 | 0.42 | 0.38 | 0.49 | 0.07 | 0.28 |
| Pension Funding | 0.34* | 0.33 | 0.34* | 0.03 | 0.33 | 0.18 |
| Percent Operating Accrual | -0.33* | -0.22 | -0.27 | -0.39 | -0.27 | -0.33 |
| Percent Total Accrual | -0.54** | -0.60* | -0.57** | -0.20 | 0.16 | -0.02 |
| Profit Margin | 0.60** | 0.61* | 0.61** | 0.16 | -0.02 | 0.07 |
| Profitability | 0.56*** | 0.68** | 0.62** | 0.56* | 0.39 | 0.48* |
| ROE | 0.64** | 0.64* | 0.64** | 0.52 | 0.30 | 0.41 |
| Sales Growth | 0.45 | 0.53 | 0.49 | 0.05 | -0.41 | -0.18 |
| Tax | -0.57* | -0.51 | -0.54 | 0.13 | 0.38 | 0.25 |
| Z-Score | 0.23 | 0.34 | 0.28 | -0.03 | -0.11 | -0.07 |

## Table 8: Equal-Weighted Covariance Factor Portfolio Returns

This table reports annual mean returns of equal-weighted portfolios of factors built from factor loadings instead of characteristics. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | 0.02 | 0.03 | 0.02 | 0.00 | 0.02 | 0.01 |
| Volatility | 0.65 | 0.67 | 0.63 | 0.88 | 1.03 | 0.93 |
| Sharpe Ratio | 0.02 | 0.04 | 0.03 | 0.00 | 0.02 | 0.01 |
| t-stat | 0.39 | 0.68 | 0.56 | -0.07 | 0.27 | 0.12 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | -0.01 | -0.02 | -0.01 | 0.12 | 0.12 | 0.12 |
| Volatility | 1.03 | 1.04 | 0.99 | 1.12 | 0.89 | 0.89 |
| Sharpe Ratio | -0.01 | -0.02 | -0.01 | 0.11 | 0.13 | 0.14 |
| t-stat | -0.09 | -0.34 | -0.23 | 1.86 | 2.25 | 2.30 |

## Table 9: Equal-Weighted Factor Portfolio Alphas: Covariances vs. Characteristics

This table reports annual alphas and betas of an equal-weighted portfolio of factors built on covariances against an equal-weighted portfolio of factors built on characteristics in Panel A. The reverse regression is shown in Panel B. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all 87 calculable factors from using McLean and Pontiff (2016).

Panel A: Covariances Regressed Against Characteristics

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | -0.08 | -0.12 | -0.11 | -0.10 | -0.11 | -0.12 |
| Alpha t-stat | -3.27 | -5.07 | -5.36 | -2.63 | -3.82 | -4.27 |
| Beta | 0.86 | 0.90 | 0.95 | 0.87 | 1.11 | 1.11 |
| Beta t-stat | 21.09 | 24.34 | 27.15 | 17.79 | 30.73 | 29.44 |
| R-squared | 61% | 68% | 72% | 53% | 77% | 76% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | -0.12 | -0.21 | -0.17 | 0.03 | -0.10 | -0.04 |
| Alpha t-stat | -2.86 | -4.66 | -4.49 | 0.54 | -2.58 | -1.06 |
| Beta | 1.30 | 1.21 | 1.34 | 0.73 | 0.93 | 0.92 |
| Beta t-stat | 19.49 | 17.11 | 20.01 | 9.06 | 18.13 | 14.51 |
| R-squared | 58% | 51% | 59% | 23% | 54% | 43% |

Panel A: Characteristics Regressed Against Covariances

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.10 | 0.14 | 0.12 | 0.11 | 0.11 | 0.11 |
| Alpha t-stat | 4.55 | 6.83 | 6.82 | 3.58 | 4.54 | 5.04 |
| Beta | 0.71 | 0.76 | 0.77 | 0.61 | 0.69 | 0.68 |
| Beta t-stat | 21.09 | 24.34 | 27.15 | 17.79 | 30.73 | 29.44 |
| R-squared | 61% | 68% | 72% | 53% | 77% | 76% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.09 | 0.16 | 0.13 | 0.09 | 0.16 | 0.12 |
| Alpha t-stat | 3.73 | 6.38 | 5.80 | 2.27 | 5.72 | 4.29 |
| Beta | 0.44 | 0.42 | 0.44 | 0.31 | 0.58 | 0.47 |
| Beta t-stat | 19.49 | 17.11 | 20.01 | 9.06 | 18.13 | 14.51 |
| R-squared | 58% | 51% | 59% | 23% | 54% | 43% |

## Table 10: Percentage of Return Attributable to Long Portfolio

This table reports percentage of return attributable to the long portfolio. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

Panel A: Event Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 70% | 76% | 73% | 58% | 83% | 70% |
| Change in Profit Margin | -45% | 76% | 15% | 104% | 72% | 88% |
| Chg. Forecast plus Accrual | 38% | 74% | 56% | -28% | 100% | 36% |
| Dividend Initiation | 28% | 9% | 19% | -102% | 43% | -29% |
| Dividend Omission | 32% | 64% | 48% | 54% | -38% | 8% |
| Dividends | -320% | 61% | -129% | 7% | 39% | 23% |
| Down Forecast | 52% | 69% | 60% | 21% | 5497% | 2759% |
| Earnings Surprise | 41% | 71% | 56% | -71% | 2694% | 1311% |
| Growth in Inventory | 87% | 65% | 76% | 84% | -315% | -116% |
| Growth in LTNOA | 28% | 57% | 43% | 53% | 51% | 52% |
| IPO | -65% | 28% | -19% | -42% | 6% | -18% |
| IPO no R&D | 13% | 19% | 16% | 78% | 30% | 54% |
| Post Earnings Drift | 75% | 179% | 127% | 32% | 98% | 65% |
| R&D Increases | 114% | 269% | 192% | 88% | 183% | 136% |
| Repurchases | 101% | 93% | 97% | 68% | 42% | 55% |
| Revenue Surprises | 29% | 52% | 41% | 72% | 148% | 110% |
| Share Issuance 1-Year | 67% | 56% | 61% | 55% | 44% | 49% |
| Share Issuance 5-Year | 68% | 54% | 61% | 57% | 73% | 65% |
| Sustainable Growth | 24% | 35% | 30% | 57% | 54% | 55% |
| Total External Finance | 43% | 50% | 46% | 19% | 13% | 16% |
| Up Forecast | 52% | 70% | 61% | 23% | 129% | 76% |
| ΔCapex - ΔIndustry Capex | 64% | 116% | 90% | 58% | 74% | 66% |
| ΔSales - ΔInventory | 48% | 77% | 63% | 2% | 55% | 28% |
| ΔSales - ΔSG&A | 20% | 75% | 47% | 52% | 66% | 59% |
| ΔWork. capital | 83% | 7% | 45% | 30% | 59% | 45% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 64% | 59% | 62% | 88% | 66% | 77% |
| Change in Profit Margin | 23% | 81% | 52% | 88% | -160% | -36% |
| Chg. Forecast plus Accrual | 100% | 94% | 97% | 21% | 64% | 42% |
| Dividend Initiation | 86% | -557% | -235% | 31% | 75% | 53% |
| Dividend Omission | 45% | 51% | 48% | 149% | 15% | 82% |
| Dividends | 58% | 7% | 33% | 57% | 34% | 45% |
| Down Forecast | 78% | 87% | 83% | 47% | 68% | 57% |
| Earnings Surprise | 25% | 54% | 40% | 141% | 54% | 98% |
| Growth in Inventory | 4% | 60% | 32% | -36% | 46% | 5% |
| Growth in LTNOA | 438% | 10% | 224% | 96% | 60% | 78% |
| IPO | -864% | 31% | -417% | 76% | 22% | 49% |
| IPO no R&D | -40% | 52% | 6% | 81% | 9% | 45% |
| Post Earnings Drift | 280% | 157% | 219% | 115% | 132% | 123% |
| R&D Increases | 111% | 116% | 113% | 177% | 62% | 119% |
| Repurchases | 416% | 95% | 256% | -150% | 83% | -33% |
| Revenue Surprises | -17% | 49% | 16% | 100% | 45% | 72% |
| Share Issuance 1-Year | 64% | 69% | 67% | 66% | 45% | 55% |
| Share Issuance 5-Year | 6% | 72% | 39% | -118% | 46% | -36% |
| Sustainable Growth | 69% | -49% | 10% | -59% | 48% | -6% |
| Total External Finance | 45% | 56% | 51% | 63% | 48% | 55% |
| Up Forecast | 76% | 88% | 82% | 47% | 72% | 59% |
| ΔCapex - ΔIndustry Capex | 72% | -985% | -456% | -222% | 34% | -94% |
| ΔSales - ΔInventory | 2518% | -74% | 1222% | -10% | 53% | 22% |
| ΔSales - ΔSG&A | -47% | -1016% | -531% | -34% | 53% | 10% |
| ΔWork. capital | 118% | -10% | 54% | 24% | 39% | 31% |

Panel C: Valuation Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 129% | 346% | 238% | 73% | 135% | 104% |
| Book-to-Market | 139% | 54% | 96% | 327% | 35% | 181% |
| Cash Flow/MV | 60% | 51% | 56% | 65% | 44% | 54% |
| Dividend Yield | 75% | 88% | 82% | -78% | 134% | 28% |
| Earnings-to-Price | 57% | 56% | 56% | 65% | 49% | 57% |
| Enterprise Component of B/P | 31% | 60% | 45% | 48% | 58% | 53% |
| Enterprise Multiple | 53% | 47% | 50% | 47% | 41% | 44% |
| Leverage Component of B/P | 88% | 3302% | 1695% | 87% | 202% | 144% |
| Org. Capital | 32% | 70% | 51% | 25% | 64% | 44% |
| R&D/MV | 183% | 312% | 248% | 88% | 88% | 88% |
| Sales/Price | 60% | 48% | 54% | 55% | 41% | 48% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 17% | 1216% | 616% | 167% | -28720% | -14276% |
| Book-to-Market | 95% | 63% | 79% | 90% | 63% | 77% |
| Cash Flow/MV | 59% | 48% | 54% | 75% | 66% | 71% |
| Dividend Yield | 55% | 62% | 59% | 91% | 54% | 72% |
| Earnings-to-Price | 51% | 54% | 52% | 94% | 64% | 79% |
| Enterprise Component of B/P | 58% | 67% | 62% | 97% | 59% | 78% |
| Enterprise Multiple | 60% | 58% | 59% | 102% | 49% | 76% |
| Leverage Component of B/P | 61% | 469% | 265% | 63% | 145% | 104% |
| Org. Capital | -9% | 12% | 2% | 35% | 61% | 48% |
| R&D/MV | -152% | 126% | -13% | 385% | 676% | 530% |
| Sales/Price | 59% | 61% | 60% | 87% | 52% | 70% |

Panel D: Fundamental Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 44% | 52% | 48% | 49% | 46% | 48% |
| Age | 79% | 51% | 65% | 54% | 66% | 60% |
| Asset Growth | 87% | 59% | 73% | 71% | 39% | 55% |
| Asset Turnover | 49% | 42% | 46% | 56% | 34% | 45% |
| Cash Flow Variance | 100% | 59% | 80% | 67% | 60% | 63% |
| Earnings Consistency | 409% | 25% | 217% | -7% | 60% | 27% |
| Forecast Dispersion | 48% | 87% | 67% | -9% | -306% | -157% |
| Gross Profitability | 58% | 63% | 60% | 63% | 66% | 65% |
| G-Score | 12% | 47% | 29% | 41% | 32% | 36% |
| F-Score | 51% | 57% | 54% | 56% | 152% | 104% |
| Herfindahl | 63% | 40% | 51% | -21% | 40% | 10% |
| Investment | 69% | 55% | 62% | 224% | 68% | 146% |
| Leverage | 83% | 101% | 92% | 80% | 70% | 75% |
| M/B and Accruals | 15% | 40% | 28% | 43% | 4% | 23% |
| NOA | 34% | 238% | 136% | 42% | 41% | 41% |
| Operating Leverage | 52% | 70% | 61% | 51% | 35% | 43% |
| O-Score | -18% | 58% | 20% | 17% | 111% | 64% |
| Pension Funding | -1612% | 130% | -741% | -71% | -97% | -84% |
| Percent Operating Accrual | 1% | 38% | 19% | 24% | 49% | 36% |
| Percent Total Accrual | 156% | 28% | 92% | -26% | 50% | 12% |
| Profit Margin | 26% | 48% | 37% | 13% | 1355% | 684% |
| Profitability | 54% | 53% | 53% | 47% | -434% | -193% |
| ROE | 37% | 54% | 45% | 41% | 118% | 80% |
| Sales Growth | 122% | 197% | 160% | -377% | 91% | -143% |
| Tax | 107% | 67% | 87% | 6% | 115% | 61% |
| Z-Score | 59% | 61% | 60% | -122% | 82% | -20% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 69% | 47% | 58% | -11% | 48% | 18% |
| Age | -37% | 32% | -3% | 46% | 67% | 57% |
| Asset Growth | -58% | 57% | 0% | 230% | 63% | 147% |
| Asset Turnover | 14% | 61% | 38% | 51% | 25% | 38% |
| Cash Flow Variance | 138% | 46% | 92% | -12% | 55% | 22% |
| Earnings Consistency | 40% | 246% | 143% | 94% | 35% | 64% |
| Forecast Dispersion | 82% | 72% | 77% | 76% | 95% | 85% |
| Gross Profitability | 57% | 55% | 56% | 62% | 52% | 57% |
| G-Score | -8728% | 13% | -4358% | 18% | 11% | 15% |
| F-Score | 50% | 48% | 49% | 76% | 55% | 66% |
| Herfindahl | 69% | 54% | 61% | 122% | 65% | 94% |
| Investment | 52% | 55% | 53% | -2% | 11% | 4% |
| Leverage | 76% | 94% | 85% | 91% | 26% | 59% |
| M/B and Accruals | 56% | 40% | 48% | 5% | 35% | 20% |
| NOA | 21% | -9% | 6% | 56% | 112% | 84% |
| Operating Leverage | 37% | 66% | 52% | 39% | 61% | 50% |
| O-Score | 107% | 51% | 79% | 556% | 34% | 295% |
| Pension Funding | 82% | 109% | 95% | 23% | 47% | 35% |
| Percent Operating Accrual | 92% | 11% | 51% | 61% | 41% | 51% |
| Percent Total Accrual | 95% | 2% | 48% | -14% | 44% | 15% |
| Profit Margin | 19% | 52% | 36% | 146% | 59% | 103% |
| Profitability | 55% | 51% | 53% | 83% | 61% | 72% |
| ROE | 37% | 52% | 45% | 43% | 71% | 57% |
| Sales Growth | -23% | -278% | -150% | -110% | 51% | -29% |
| Tax | 59% | 43% | 51% | 171% | 118% | 145% |
| Z-Score | 25% | 82% | 53% | 74% | 2% | 38% |

## Table 11: Factor Volatilities

This table reports the standard deviation of large and small factor portfolios. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

Panel A: Event Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 1.33 | 0.82 | 0.89 | 1.85 | 1.34 | 1.27 |
| Change in Profit Margin | 1.63 | 1.10 | 1.22 | 2.05 | 1.70 | 1.62 |
| Chg. Forecast plus Accrual | 2.95 | 2.08 | 2.12 | 4.09 | 3.15 | 2.86 |
| Dividend Initiation | 3.57 | 2.60 | 2.34 | 5.23 | 3.60 | 3.53 |
| Dividend Omission | 2.73 | 2.87 | 2.61 | 3.16 | 2.20 | 2.43 |
| Dividends | 3.10 | 2.79 | 2.70 | 4.33 | 3.94 | 3.91 |
| Down Forecast | 1.99 | 1.58 | 1.54 | 3.04 | 2.64 | 2.26 |
| Earnings Surprise | 1.76 | 1.38 | 1.39 | 2.34 | 1.78 | 1.69 |
| Growth in Inventory | 1.45 | 1.52 | 1.28 | 1.80 | 1.60 | 1.38 |
| Growth in LTNOA | 2.17 | 1.96 | 1.79 | 2.79 | 1.93 | 2.00 |
| IPO | 2.66 | 1.82 | 1.89 | 3.68 | 2.72 | 2.49 |
| IPO no R&D | 3.00 | 1.64 | 1.73 | 3.96 | 2.29 | 2.30 |
| Post Earnings Drift | 3.01 | 1.78 | 2.15 | 3.31 | 1.93 | 2.36 |
| R&D Increases | 2.18 | 1.60 | 1.46 | 3.32 | 2.43 | 2.08 |
| Repurchases | 2.63 | 2.28 | 2.28 | 2.50 | 2.25 | 2.12 |
| Revenue Surprises | 2.11 | 2.23 | 1.97 | 2.41 | 1.88 | 1.89 |
| Share Issuance 1-Year | 2.05 | 2.05 | 1.86 | 2.70 | 3.06 | 2.62 |
| Share Issuance 5-Year | 1.88 | 2.10 | 1.76 | 2.13 | 2.78 | 2.05 |
| Sustainable Growth | 2.35 | 2.30 | 2.16 | 2.95 | 1.89 | 2.12 |
| Total External Finance | 2.13 | 1.54 | 1.63 | 2.70 | 2.38 | 2.15 |
| Up Forecast | 1.95 | 1.55 | 1.52 | 2.98 | 2.62 | 2.29 |
| ΔCapex - ΔIndustry Capex | 2.06 | 1.55 | 1.51 | 2.64 | 1.83 | 1.97 |
| ΔNoncurrent Op. Assets | 2.32 | 1.57 | 1.65 | 2.97 | 2.90 | 2.60 |
| ΔSales - ΔInventory | 2.48 | 2.57 | 2.32 | 3.15 | 2.13 | 2.35 |
| ΔSales - ΔSG&A | 2.51 | 2.52 | 2.31 | 3.08 | 1.80 | 2.13 |
| ΔWork. capital | 1.51 | 1.36 | 1.25 | 2.31 | 1.62 | 1.72 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 1.51 | 0.99 | 1.02 | 4.30 | 1.80 | 2.30 |
| Change in Profit Margin | 2.04 | 1.20 | 1.46 | 3.63 | 2.17 | 2.43 |
| Chg. Forecast plus Accrual | 2.93 | 2.23 | 2.20 | 4.98 | 3.85 | 3.42 |
| Dividend Initiation | 4.24 | 3.10 | 3.09 | 5.07 | 3.95 | 3.21 |
| Dividend Omission | 3.03 | 3.54 | 3.13 | 5.16 | 3.36 | 3.27 |
| Dividends | 2.89 | 2.49 | 2.19 | 4.90 | 2.80 | 3.19 |
| Down Forecast | 1.78 | 1.62 | 1.45 | 3.75 | 2.47 | 2.38 |
| Earnings Surprise | 1.99 | 1.42 | 1.51 | 4.55 | 2.88 | 2.96 |
| Growth in Inventory | 1.85 | 1.83 | 1.61 | 3.16 | 2.21 | 2.13 |
| Growth in LTNOA | 2.05 | 2.55 | 1.93 | 5.31 | 2.14 | 3.16 |
| IPO | 2.94 | 1.88 | 1.99 | 5.87 | 2.47 | 3.23 |
| IPO no R&D | 2.79 | 2.04 | 1.56 | 4.15 | 3.05 | 2.68 |
| Post Earnings Drift | 3.06 | 2.28 | 2.07 | 2.63 | 2.88 | 1.97 |
| R&D Increases | 2.62 | 2.20 | 1.80 | 6.00 | 4.91 | 4.01 |
| Repurchases | 2.30 | 2.46 | 2.02 | 3.85 | 3.51 | 2.70 |
| Revenue Surprises | 2.58 | 2.76 | 2.46 | 5.45 | 3.23 | 3.48 |
| Share Issuance 1-Year | 2.03 | 2.02 | 1.73 | 4.96 | 2.29 | 2.84 |
| Share Issuance 5-Year | 2.55 | 2.53 | 2.21 | 5.53 | 2.68 | 3.34 |
| Sustainable Growth | 2.50 | 2.99 | 2.57 | 5.32 | 3.14 | 3.51 |
| Total External Finance | 2.26 | 1.74 | 1.68 | 4.42 | 2.51 | 2.78 |
| Up Forecast | 1.78 | 1.60 | 1.43 | 3.81 | 2.54 | 2.41 |
| ΔCapex - ΔIndustry Capex | 2.39 | 1.47 | 1.61 | 3.44 | 2.16 | 2.23 |
| ΔNoncurrent Op. Assets | 2.80 | 1.72 | 1.77 | 4.47 | 2.12 | 2.68 |
| ΔSales - ΔInventory | 2.75 | 3.02 | 2.69 | 5.13 | 2.64 | 3.12 |
| ΔSales - ΔSG&A | 2.71 | 2.99 | 2.68 | 5.10 | 3.00 | 3.22 |
| ΔWork. capital | 1.74 | 1.63 | 1.47 | 4.64 | 2.17 | 2.63 |

Panel B: Market Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 4.75 | 5.04 | 4.77 | 4.87 | 6.00 | 5.23 |
| Age-Momentum | 4.16 | 3.24 | 3.46 | 5.79 | 4.17 | 4.59 |
| Amihud's Measure | 2.46 | 2.73 | 2.29 | 2.34 | 2.14 | 1.77 |
| Beta | 4.83 | 4.30 | 4.44 | 5.47 | 5.56 | 5.33 |
| Bid/Ask Spread | 2.11 | 2.17 | 1.81 | 4.84 | 3.31 | 3.19 |
| CoSkewness | 1.64 | 1.28 | 1.20 | 2.84 | 2.26 | 2.19 |
| Idiosyncratic Risk | 4.14 | 4.46 | 4.19 | 4.91 | 6.54 | 5.54 |
| Industry momentum | 3.65 | 2.84 | 3.12 | 4.54 | 4.61 | 4.35 |
| Lagged Momentum | 3.63 | 3.23 | 3.25 | 4.21 | 3.57 | 3.61 |
| Long-term Reversal | 3.25 | 2.93 | 2.89 | 3.46 | 2.51 | 2.68 |
| Max | 4.14 | 4.09 | 4.00 | 5.15 | 6.14 | 5.46 |
| Momentum | 4.60 | 4.47 | 4.41 | 4.84 | 5.32 | 4.89 |
| Momentum and LT reversal | 4.58 | 4.39 | 3.82 | 5.41 | 4.67 | 3.93 |
| Momentum-Reversal | 3.17 | 2.82 | 2.83 | 3.80 | 3.08 | 3.21 |
| Price | 2.75 | 3.37 | 2.88 | 3.47 | 3.85 | 3.45 |
| Seasonality | 1.67 | 1.69 | 1.47 | 1.97 | 1.46 | 1.38 |
| Short-term Reversal | 3.45 | 3.48 | 3.29 | 3.71 | 4.22 | 3.73 |
| Size | 1.64 | 0.91 | 1.09 | 2.22 | 1.66 | 1.53 |
| Volume | 3.46 | 3.46 | 3.28 | 5.38 | 4.98 | 4.98 |
| Volume Trend | 2.64 | 2.56 | 2.38 | 3.38 | 3.11 | 2.94 |
| Volume Variance | 2.30 | 3.14 | 2.37 | 2.47 | 4.46 | 3.02 |
| Volume-Momentum | 3.72 | 3.92 | 3.60 | 4.50 | 5.96 | 4.72 |
| Volume/MV | 3.47 | 3.57 | 3.34 | 5.18 | 5.00 | 4.90 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | 4.96 | 4.89 | 4.75 | 6.28 | 5.33 | 5.28 |
| Age-Momentum | 3.99 | 3.28 | 3.34 | 4.78 | 4.37 | 4.00 |
| Amihud's Measure | 1.83 | 1.79 | 1.43 | 5.37 | 3.87 | 3.84 |
| Beta | 4.71 | 4.94 | 4.66 | 4.91 | 4.39 | 4.31 |
| Bid/Ask Spread | 2.10 | 1.67 | 1.41 | 4.88 | 3.65 | 3.55 |
| CoSkewness | 1.69 | 1.28 | 1.20 | 3.99 | 1.95 | 2.31 |
| Idiosyncratic Risk | 3.51 | 3.81 | 3.51 | 5.65 | 4.26 | 4.43 |
| Industry momentum | 3.73 | 2.41 | 2.86 | 5.20 | 2.63 | 3.42 |
| Lagged Momentum | 3.70 | 3.49 | 3.39 | 5.27 | 3.86 | 3.85 |
| Long-term Reversal | 3.16 | 3.31 | 3.04 | 4.70 | 4.64 | 4.03 |
| Max | 3.90 | 3.67 | 3.63 | 4.78 | 3.72 | 3.63 |
| Momentum | 4.74 | 4.57 | 4.49 | 5.72 | 4.93 | 4.86 |
| Momentum and LT reversal | 4.86 | 4.70 | 4.01 | 9.34 | 7.79 | 7.34 |
| Momentum-Reversal | 3.38 | 3.24 | 3.09 | 5.01 | 3.96 | 3.91 |
| Price | 2.49 | 2.68 | 2.35 | 4.76 | 4.63 | 4.17 |
| Seasonality | 2.32 | 2.47 | 2.20 | 4.17 | 2.31 | 2.46 |
| Short-term Reversal | 3.65 | 3.51 | 3.36 | 5.47 | 4.35 | 4.32 |
| Size | 1.78 | 1.03 | 1.18 | 2.97 | 1.66 | 1.74 |
| Volume | 2.90 | 2.44 | 2.37 | 5.22 | 4.62 | 4.39 |
| Volume Trend | 3.01 | 2.86 | 2.73 | 5.85 | 3.29 | 3.64 |
| Volume Variance | 2.14 | 2.48 | 1.98 | 6.20 | 4.30 | 4.52 |
| Volume-Momentum | 4.02 | 4.10 | 3.84 | 4.91 | 5.28 | 4.39 |
| Volume/MV | 2.84 | 2.62 | 2.42 | 5.47 | 4.69 | 4.48 |

Panel C: Valuation Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 2.52 | 2.47 | 2.32 | 3.55 | 4.40 | 3.59 |
| Book-to-Market | 2.68 | 2.88 | 2.54 | 3.20 | 4.13 | 3.38 |
| Cash Flow/MV | 2.38 | 2.85 | 2.42 | 3.59 | 4.84 | 3.90 |
| Dividend Yield | 3.39 | 3.05 | 3.06 | 5.33 | 4.34 | 4.61 |
| Earnings-to-Price | 2.67 | 2.79 | 2.59 | 3.77 | 4.81 | 4.03 |
| Enterprise Component of B/P | 2.25 | 2.06 | 1.84 | 2.35 | 2.12 | 1.92 |
| Enterprise Multiple | 2.28 | 2.16 | 2.01 | 3.27 | 3.97 | 3.29 |
| Leverage Component of B/P | 1.73 | 1.52 | 1.49 | 3.55 | 3.17 | 3.14 |
| Org. Capital | 1.24 | 1.59 | 1.09 | 1.90 | 2.27 | 1.49 |
| R&D/MV | 2.11 | 2.09 | 1.83 | 2.59 | 3.57 | 2.64 |
| Sales/Price | 2.64 | 2.75 | 2.49 | 3.37 | 4.24 | 3.54 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 2.69 | 2.22 | 2.22 | 4.68 | 3.57 | 3.31 |
| Book-to-Market | 2.83 | 2.85 | 2.53 | 4.49 | 3.48 | 3.39 |
| Cash Flow/MV | 2.28 | 2.64 | 2.22 | 4.82 | 3.06 | 3.29 |
| Dividend Yield | 2.85 | 2.76 | 2.64 | 4.23 | 3.08 | 3.18 |
| Earnings-to-Price | 2.82 | 2.71 | 2.58 | 4.67 | 2.68 | 3.09 |
| Enterprise Component of B/P | 2.53 | 2.59 | 2.14 | 3.99 | 2.77 | 2.67 |
| Enterprise Multiple | 2.16 | 1.97 | 1.78 | 4.74 | 2.72 | 3.00 |
| Leverage Component of B/P | 1.33 | 1.13 | 0.88 | 2.46 | 1.62 | 1.61 |
| Org. Capital | 1.45 | 2.46 | 1.59 | 3.69 | 3.00 | 2.88 |
| R&D/MV | 2.27 | 2.13 | 1.91 | 5.28 | 2.71 | 3.31 |
| Sales/Price | 2.68 | 2.78 | 2.48 | 4.47 | 3.19 | 3.22 |

Panel D: Fundamental Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 2.11 | 1.14 | 1.38 | 2.71 | 1.77 | 1.87 |
| Age | 2.82 | 2.09 | 2.23 | 3.18 | 2.95 | 2.44 |
| Asset Growth | 2.59 | 2.57 | 2.40 | 2.99 | 2.02 | 2.20 |
| Asset Turnover | 1.97 | 1.48 | 1.48 | 2.63 | 2.48 | 2.21 |
| Cash Flow Variance | 2.56 | 2.18 | 2.16 | 2.90 | 2.81 | 2.61 |
| Earnings Consistency | 2.99 | 2.23 | 2.02 | 3.79 | 3.49 | 2.56 |
| Forecast Dispersion | 3.28 | 2.83 | 2.85 | 3.86 | 3.75 | 3.49 |
| Gross Profitability | 2.62 | 1.96 | 2.00 | 3.06 | 2.54 | 2.41 |
| G-Score | 4.07 | 2.66 | 2.28 | 5.43 | 3.77 | 3.02 |
| F-Score | 1.61 | 1.43 | 1.29 | 2.01 | 2.43 | 1.87 |
| Herfindahl | 2.80 | 3.18 | 2.79 | 3.00 | 3.02 | 2.50 |
| Investment | 1.38 | 0.99 | 1.00 | 2.06 | 1.49 | 1.50 |
| Leverage | 1.67 | 1.02 | 1.14 | 2.31 | 1.73 | 1.66 |
| M/B and Accruals | 3.18 | 3.01 | 2.18 | 3.87 | 4.71 | 3.29 |
| NOA | 1.87 | 1.80 | 1.52 | 2.51 | 3.34 | 2.60 |
| Operating Leverage | 2.15 | 1.35 | 1.44 | 2.56 | 2.45 | 2.05 |
| O-Score | 2.09 | 1.41 | 1.54 | 2.70 | 2.29 | 2.20 |
| Pension Funding | 2.07 | 2.93 | 2.02 | 2.75 | 4.13 | 2.60 |
| Percent Operating Accrual | 1.50 | 1.69 | 1.33 | 1.95 | 1.55 | 1.35 |
| Percent Total Accrual | 1.94 | 1.32 | 1.41 | 2.27 | 1.61 | 1.57 |
| Profit Margin | 1.89 | 2.10 | 1.81 | 2.15 | 3.60 | 2.47 |
| Profitability | 2.53 | 1.87 | 1.85 | 2.99 | 2.84 | 2.50 |
| ROE | 2.21 | 2.03 | 1.93 | 2.25 | 2.87 | 2.22 |
| Sales Growth | 2.59 | 2.64 | 2.37 | 3.16 | 1.87 | 2.15 |
| Tax | 1.67 | 2.15 | 1.65 | 1.98 | 1.39 | 1.37 |
| Z-Score | 2.82 | 2.54 | 2.47 | 3.40 | 4.34 | 3.60 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | 2.24 | 1.32 | 1.50 | 5.67 | 2.23 | 3.14 |
| Age | 2.74 | 2.04 | 2.08 | 5.11 | 2.70 | 3.37 |
| Asset Growth | 2.88 | 3.43 | 2.95 | 5.34 | 3.30 | 3.53 |
| Asset Turnover | 2.10 | 1.70 | 1.51 | 4.85 | 2.47 | 3.09 |
| Cash Flow Variance | 2.42 | 2.28 | 2.06 | 4.43 | 3.29 | 3.15 |
| Earnings Consistency | 3.13 | 2.21 | 2.15 | 6.41 | 3.87 | 3.84 |
| Forecast Dispersion | 3.14 | 2.63 | 2.62 | 5.28 | 3.56 | 3.87 |
| Gross Profitability | 2.85 | 1.67 | 1.92 | 3.60 | 3.15 | 2.85 |
| G-Score | 5.28 | 6.72 | 3.67 | 9.46 | 5.25 | 5.86 |
| F-Score | 1.99 | 1.48 | 1.51 | 4.32 | 2.25 | 2.51 |
| Herfindahl | 3.19 | 4.57 | 3.54 | 3.99 | 3.92 | 3.56 |
| Investment | 1.47 | 1.44 | 1.21 | 3.01 | 1.54 | 1.82 |
| Leverage | 1.83 | 1.05 | 1.20 | 2.98 | 2.02 | 1.97 |
| M/B and Accruals | 4.15 | 3.36 | 2.82 | 7.67 | 5.07 | 4.90 |
| NOA | 2.41 | 1.82 | 1.53 | 4.74 | 2.13 | 2.88 |
| Operating Leverage | 2.73 | 1.56 | 1.69 | 3.71 | 2.45 | 2.59 |
| O-Score | 2.40 | 1.60 | 1.75 | 4.88 | 2.65 | 3.07 |
| Pension Funding | 2.33 | 3.48 | 1.77 | 3.21 | 3.87 | 3.06 |
| Percent Operating Accrual | 1.73 | 1.52 | 1.34 | 4.68 | 2.76 | 3.02 |
| Percent Total Accrual | 2.37 | 1.64 | 1.75 | 5.52 | 2.28 | 3.08 |
| Profit Margin | 2.35 | 2.51 | 2.23 | 4.90 | 2.57 | 2.92 |
| Profitability | 2.94 | 2.39 | 2.19 | 3.28 | 3.02 | 2.55 |
| ROE | 2.91 | 2.76 | 2.62 | 4.67 | 2.89 | 3.00 |
| Sales Growth | 2.83 | 2.99 | 2.74 | 6.35 | 3.93 | 4.31 |
| Tax | 2.08 | 3.08 | 2.32 | 3.98 | 2.84 | 2.81 |
| Z-Score | 3.05 | 2.29 | 2.38 | 4.13 | 3.09 | 2.88 |

## Table 12: Factor Allocation

This table reports the excess returns of a long-short portfolio of factors in which the strategy buys factors that are in the top 30th percentile of inception-to-date factor returns and sells factors that are in the bottom 30th percentile of inception-to-date factor returns. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

Panel A: Choosing Factors Based on Historical Return

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | -0.13 | 0.19 | 0.00 | -0.28 | -0.15 | -0.19 |
| Volatility | 1.39 | 1.07 | 1.19 | 2.01 | 1.84 | 1.74 |
| Sharpe Ratio | -0.09 | 0.17 | 0.00 | -0.14 | -0.08 | -0.11 |
| t-stat | -1.35 | 2.58 | -0.03 | -2.04 | -1.22 | -1.66 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | -0.04 | 0.22 | 0.12 | -0.10 | 0.44 | 0.08 |
| Volatility | 1.20 | 1.14 | 1.13 | 1.43 | 1.47 | 1.20 |
| Sharpe Ratio | -0.03 | 0.20 | 0.11 | -0.07 | 0.30 | 0.07 |
| t-stat | -0.47 | 2.95 | 1.65 | -1.05 | 4.50 | 1.03 |

Panel B: Choosing Factors Based on Historical Sharpe Ratio

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | -0.14 | 0.18 | 0.03 | -0.25 | -0.16 | -0.17 |
| Volatility | 1.27 | 0.91 | 0.87 | 1.86 | 1.60 | 1.59 |
| Sharpe Ratio | -0.11 | 0.20 | 0.03 | -0.13 | -0.10 | -0.11 |
| t-stat | -1.55 | 3.19 | 0.63 | -1.91 | -1.06 | -1.30 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Mean Excess Return | -0.01 | 0.22 | 0.08 | -0.10 | 0.39 | 0.12 |
| Volatility | 1.13 | 1.01 | 1.01 | 1.54 | 1.47 | 1.15 |
| Sharpe Ratio | -0.01 | 0.22 | 0.08 | -0.06 | 0.27 | 0.10 |
| t-stat | -0.18 | 3.17 | 1.11 | -0.83 | 3.98 | 1.67 |

## Table 13: Factor Returns Against Time

This table reports factor excess returns against dates represented in days divided by 1 million for scaling purposes. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

Panel A: Equal-weighted portfolio of factors

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -0.21 | -0.21 | -0.22 | -0.21 | -0.22 | -0.22 |
| Standard Error | 0.14 | 0.15 | 0.14 | 0.18 | 0.20 | 0.18 |
| t-Stat | -1.51 | -1.40 | -1.58 | -1.16 | -1.14 | -1.26 |
| R-Squared | 0.8% | 0.7% | 0.9% | 0.5% | 0.5% | 0.6% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -0.08 | -0.14 | -0.11 | -0.15 | -0.25 | -0.20 |
| Standard Error | 0.15 | 0.15 | 0.14 | 0.18 | 0.17 | 0.15 |
| t-Stat | -0.55 | -0.94 | -0.83 | -0.87 | -1.47 | -1.32 |
| R-Squared | 0.1% | 0.3% | 0.2% | 0.3% | 0.8% | 0.6% |

Panel B: Long-short portfolios of expected returns using inception-to-date average coefficients

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -1.50 | -0.86 | -1.18 | -0.98 | -0.54 | -0.76 |
| Standard Error | 0.79 | 0.94 | 0.78 | 0.90 | 1.11 | 0.90 |
| t-Stat | -1.90 | -0.92 | -1.52 | -1.09 | -0.48 | -0.84 |
| R-Squared | 1.3% | 0.3% | 0.8% | 0.4% | 0.1% | 0.3% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -1.83 | 0.08 | -0.88 | -1.72 | -1.21 | -1.47 |
| Standard Error | 0.84 | 0.98 | 0.82 | 0.96 | 1.14 | 0.90 |
| t-Stat | -2.19 | 0.08 | -1.07 | -1.80 | -1.06 | -1.64 |
| R-Squared | 1.7% | 0.0% | 0.4% | 1.1% | 0.4% | 1.0% |

Panel C: Long-short portfolios of expected returns using most recent coefficients

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -1.88 | -3.92 | -2.90 | -0.31 | -3.50 | -1.91 |
| Standard Error | 1.09 | 1.23 | 1.09 | 1.38 | 1.51 | 1.38 |
| t-Stat | -1.73 | -3.19 | -2.67 | -0.22 | -2.32 | -1.38 |
| R-Squared | 1.1% | 3.5% | 2.5% | 0.0% | 1.9% | 0.7% |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Coefficient | -2.39 | -3.03 | -2.71 | -2.24 | -2.72 | -2.48 |
| Standard Error | 1.02 | 1.25 | 1.06 | 1.22 | 1.34 | 1.14 |
| t-Stat | -2.34 | -2.43 | -2.56 | -1.84 | -2.03 | -2.17 |
| R-Squared | 1.9% | 2.1% | 2.3% | 1.2% | 1.4% | 1.7% |

## Table 14: Factor One-Way Turnover

This table reports monthly one-way turnover of factors the average of large and small portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).

Panel A: Event Anomalies

| Factor | Global | United States | Developed ex U.S. | Emerging Markets |
|---|---|---|---|---|
| Change in Asset Turnover | 12% | 13% | 12% | 12% |
| Change in Profit Margin | 13% | 14% | 13% | 13% |
| Chg. Forecast plus Accrual | 114% | 125% | 113% | 118% |
| Dividend Initiation | 36% | 48% | 41% | 45% |
| Dividend Omission | 14% | 19% | 12% | 24% |
| Dividends | 6% | 5% | 7% | 8% |
| Down Forecast | 110% | 121% | 109% | 112% |
| Earnings Surprise | 38% | 43% | 37% | 37% |
| Growth in Inventory | 11% | 11% | 11% | 12% |
| Growth in LTNOA | 10% | 11% | 11% | 10% |
| IPO | 8% | 8% | 7% | 7% |
| IPO no R&D | 9% | 10% | 10% | 8% |
| Post Earnings Drift | 37% | 40% | 40% | 35% |
| R&D Increases | 12% | 13% | 13% | 13% |
| Repurchases | 6% | 7% | 7% | 8% |
| Revenue Surprises | 30% | 33% | 32% | 33% |
| Share Issuance 1-Year | 9% | 10% | 9% | 10% |
| Share Issuance 5-Year | 5% | 5% | 6% | 7% |
| Sustainable Growth | 11% | 11% | 12% | 12% |
| Total External Finance | 10% | 10% | 10% | 10% |
| Up Forecast | 111% | 123% | 109% | 112% |
| ΔCapex - ΔIndustry Capex | 10% | 11% | 9% | 11% |
| ΔSales - ΔInventory | 9% | 9% | 10% | 10% |
| ΔSales - ΔSG&A | 9% | 9% | 10% | 10% |
| ΔWork. capital | 13% | 13% | 13% | 13% |

Panel B: Market Anomalies

| Factor | Global | United States | Developed ex U.S. | Emerging Markets |
|---|---|---|---|---|
| 52-Week High | 63% | 70% | 62% | 65% |
| Age-Momentum | 13% | 13% | 13% | 13% |
| Amihud's Measure | 18% | 23% | 19% | 21% |
| Beta | 6% | 6% | 6% | 7% |
| Bid/Ask Spread | 80% | 75% | 90% | 87% |
| Coskewness | 144% | 146% | 144% | 145% |
| Idiosyncratic Risk | 91% | 94% | 95% | 96% |
| Industry momentum | 59% | 66% | 63% | 64% |
| Lagged Momentum | 64% | 68% | 63% | 66% |
| Long-term Reversal | 29% | 32% | 30% | 33% |
| Max | 109% | 109% | 112% | 116% |
| Momentum | 64% | 68% | 63% | 66% |
| Momentum and LT reversal | 15% | 16% | 15% | 15% |
| Momentum-Reversal | 64% | 68% | 64% | 66% |
| Price | 16% | 24% | 15% | 19% |
| Seasonality | 5% | 6% | 5% | 6% |
| Short-term Reversal | 147% | 149% | 147% | 147% |
| Size | 32% | 32% | 29% | 39% |
| Volume | 6% | 7% | 6% | 7% |
| Volume Trend | 62% | 63% | 64% | 64% |
| Volume Variance | 5% | 6% | 5% | 6% |
| Volume-Momentum | 13% | 14% | 13% | 13% |
| Volume/MV | 6% | 7% | 6% | 6% |

Panel C: Valuation Anomalies

| Factor | Global | United States | Developed ex U.S. | Emerging Markets |
|---|---|---|---|---|
| Analyst Value | 60% | 70% | 56% | 63% |
| Book-to-Market | 6% | 6% | 6% | 7% |
| Cash Flow/MV | 7% | 8% | 7% | 8% |
| Dividend Yield | 6% | 5% | 6% | 7% |
| Earnings-to-Price | 9% | 9% | 9% | 9% |
| Enterprise Component of B/P | 6% | 7% | 6% | 7% |
| Enterprise Multiple | 8% | 8% | 8% | 9% |
| Leverage Component of B/P | 7% | 7% | 7% | 8% |
| Org. Capital | 3% | 3% | 3% | 4% |
| R&D/MV | 4% | 4% | 4% | 5% |
| Sales/Price | 5% | 6% | 5% | 6% |

Panel D: Fundamental Anomalies

| Factor | Global | United States | Developed ex U.S. | Emerging Markets |
|---|---|---|---|---|
| Accruals | 10% | 10% | 10% | 10% |
| Age | 5% | 5% | 4% | 5% |
| Asset Growth | 11% | 11% | 12% | 11% |
| Asset Turnover | 5% | 5% | 5% | 6% |
| Cash Flow Variance | 9% | 10% | 9% | 10% |
| Earnings Consistency | 11% | 11% | 11% | 12% |
| Forecast Dispersion | 75% | 87% | 74% | 82% |
| Gross Profitability | 4% | 5% | 4% | 6% |
| G-Score | 11% | 11% | 11% | 10% |
| F-Score | 12% | 13% | 12% | 12% |
| Herfindahl | 4% | 4% | 3% | 5% |
| Investment | 11% | 12% | 11% | 11% |
| Leverage | 7% | 7% | 7% | 8% |
| M/B and Accruals | 12% | 14% | 13% | 11% |
| NOA | 5% | 5% | 5% | 6% |
| Operating Leverage | 4% | 4% | 4% | 5% |
| O-Score | 6% | 6% | 6% | 7% |
| Pension Funding | 6% | 6% | 6% | 6% |
| Percent Operating Accrual | 9% | 10% | 9% | 10% |
| Percent Total Accrual | 10% | 10% | 10% | 10% |
| Profit Margin | 6% | 7% | 6% | 7% |
| Profitability | 22% | 27% | 21% | 23% |
| ROE | 7% | 8% | 7% | 8% |
| Sales Growth | 7% | 7% | 7% | 8% |
| Tax | 8% | 8% | 8% | 8% |
| Z-Score | 5% | 5% | 5% | 5% |

## Table 15: Factor CAPM Betas

This table reports CAPM betas of large and small factor portfolios. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016). * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | -0.04** | 0.01 | -0.01 | -0.09*** | -0.02 | -0.05*** |
| Change in Profit Margin | -0.03 | -0.02 | -0.03 | 0.00 | -0.01 | -0.01 |
| Chg. Forecast plus Accrual | -0.16*** | -0.14*** | -0.15*** | -0.05 | -0.06 | -0.06 |
| Dividend Initiation | -0.08 | 0.07* | -0.01 | -0.15** | -0.06 | -0.10** |
| Dividend Omission | 0.33*** | 0.35*** | 0.34*** | 0.26*** | 0.17*** | 0.21*** |
| Dividends | -0.13*** | -0.26*** | -0.19*** | -0.34*** | -0.44*** | -0.39*** |
| Down Forecast | -0.09*** | -0.11*** | -0.10*** | 0.00 | -0.08** | -0.04 |
| Earnings Surprise | -0.07*** | -0.04* | -0.05*** | -0.09*** | -0.08*** | -0.09*** |
| Growth in Inventory | -0.07*** | -0.11*** | -0.09*** | -0.05** | -0.06*** | -0.05*** |
| Growth in LTNOA | -0.07*** | -0.16*** | -0.12*** | -0.07* | -0.10*** | -0.08*** |
| IPO | -0.08** | -0.17*** | -0.12*** | -0.02 | -0.21*** | -0.11*** |
| IPO no R&D | 0.02 | -0.07*** | -0.03 | 0.13*** | 0.01 | 0.07** |
| Post Earnings Drift | 0.16*** | 0.07*** | 0.12*** | 0.23*** | 0.12*** | 0.17*** |
| R&D Increases | -0.03 | 0.01 | -0.01 | -0.16*** | 0.08** | -0.04 |
| Repurchases | -0.25*** | -0.23*** | -0.24*** | -0.12*** | -0.21*** | -0.17*** |
| Revenue Surprises | 0.00 | 0.00 | 0.00 | -0.01 | -0.06*** | -0.03 |
| Share Issuance 1-Year | -0.30*** | -0.25*** | -0.27*** | -0.31*** | -0.31*** | -0.31*** |
| Share Issuance 5-Year | -0.27*** | -0.26*** | -0.26*** | -0.25*** | -0.21*** | -0.23*** |
| Sustainable Growth | -0.25*** | -0.20*** | -0.22*** | -0.24*** | -0.12*** | -0.18*** |
| Total External Finance | -0.29*** | -0.17*** | -0.23*** | -0.32*** | -0.18*** | -0.25*** |
| Up Forecast | -0.11*** | -0.11*** | -0.11*** | -0.04 | -0.10*** | -0.07** |
| ΔCapex - ΔIndustry Capex | 0.09*** | -0.13*** | -0.02 | -0.13*** | -0.10*** | -0.11*** |
| ΔNoncurrent Op. Assets | 0.25*** | 0.05*** | 0.15*** | 0.36*** | 0.18*** | 0.27*** |
| ΔSales - ΔInventory | 0.22*** | 0.20*** | 0.21*** | 0.27*** | 0.09*** | 0.18*** |
| ΔSales - ΔSG&A | 0.24*** | 0.20*** | 0.22*** | 0.23*** | 0.05* | 0.14*** |
| ΔWork. capital | -0.13*** | -0.11*** | -0.12*** | -0.21*** | -0.14*** | -0.18*** |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Change in Asset Turnover | 0.02 | 0.03*** | 0.03* | -0.08** | -0.02 | -0.05*** |
| Change in Profit Margin | -0.05** | -0.02 | -0.04* | -0.08*** | -0.02 | -0.05*** |
| Chg. Forecast plus Accrual | -0.21*** | -0.18*** | -0.20*** | -0.01 | -0.05 | -0.03 |
| Dividend Initiation | 0.08 | 0.09** | 0.08** | 0.12*** | 0.10*** | 0.11*** |
| Dividend Omission | 0.25*** | 0.35*** | 0.30*** | 0.28*** | 0.16*** | 0.22*** |
| Dividends | -0.12*** | -0.28*** | -0.20*** | -0.12*** | -0.14*** | -0.13*** |
| Down Forecast | -0.10*** | -0.12*** | -0.11*** | 0.03 | -0.02 | 0.00 |
| Earnings Surprise | -0.08*** | -0.05*** | -0.06*** | 0.02 | -0.03 | 0.00 |
| Growth in Inventory | -0.03 | -0.07*** | -0.05*** | -0.06** | -0.09*** | -0.08*** |
| Growth in LTNOA | 0.04 | -0.14*** | -0.05** | 0.01 | -0.04** | -0.02 |
| IPO | -0.01 | -0.11*** | -0.06*** | 0.09* | -0.06*** | 0.02 |
| IPO no R&D | 0.08** | -0.11*** | -0.01 | 0.00 | -0.01 | 0.00 |
| Post Earnings Drift | -0.10*** | -0.02 | -0.06** | 0.07*** | 0.00 | 0.04* |
| R&D Increases | -0.04 | 0.04 | 0.00 | 0.07 | -0.02 | 0.03 |
| Repurchases | -0.10*** | -0.25*** | -0.17*** | -0.03 | 0.00 | -0.02 |
| Revenue Surprises | 0.00 | -0.01 | -0.01 | 0.01 | -0.02 | 0.00 |
| Share Issuance 1-Year | -0.21*** | -0.21*** | -0.21*** | -0.08* | -0.10*** | -0.09*** |
| Share Issuance 5-Year | -0.24*** | -0.25*** | -0.24*** | -0.32*** | -0.15*** | -0.24*** |
| Sustainable Growth | -0.15*** | -0.19*** | -0.17*** | -0.22*** | -0.04 | -0.13*** |
| Total External Finance | -0.18*** | -0.11*** | -0.14*** | -0.27*** | -0.15*** | -0.21*** |
| Up Forecast | -0.10*** | -0.11*** | -0.11*** | 0.02 | -0.02 | 0.00 |
| ΔCapex - ΔIndustry Capex | 0.17*** | -0.05*** | 0.06*** | 0.14*** | 0.00 | 0.07*** |
| ΔNoncurrent Op. Assets | 0.27*** | 0.00 | 0.14*** | 0.10*** | 0.08*** | 0.09*** |
| ΔSales - ΔInventory | 0.16*** | 0.18*** | 0.17*** | 0.14*** | 0.04* | 0.09*** |
| ΔSales - ΔSG&A | 0.15*** | 0.18*** | 0.17*** | 0.16*** | 0.10*** | 0.13*** |
| ΔWork. capital | -0.09*** | -0.07*** | -0.08*** | -0.05 | -0.03 | -0.04 |

Panel B: Market Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| 52-Week High | -0.60*** | -0.72*** | -0.66*** | -0.57*** | -0.91*** | -0.74*** |
| Age-Momentum | 0.14*** | 0.02 | 0.08 | 0.13* | -0.06 | 0.04 |
| Amihud's Measure | 0.06* | -0.18*** | -0.06* | 0.00 | -0.22*** | -0.11*** |
| Beta | -0.80*** | -0.74*** | -0.77*** | -0.85*** | -0.87*** | -0.86*** |
| Bid/Ask Spread | 0.09*** | 0.03 | 0.06*** | -0.08 | 0.07 | 0.00 |
| CoSkewness | -0.08*** | 0.01 | -0.03** | -0.15*** | -0.03 | -0.09*** |
| Idiosyncratic Risk | -0.60*** | -0.71*** | -0.65*** | -0.61*** | -0.89*** | -0.75*** |
| Industry momentum | -0.13*** | -0.07* | -0.10*** | -0.10 | -0.07 | -0.08 |
| Lagged Momentum | 0.02 | -0.02 | 0.00 | 0.05 | -0.04 | 0.01 |
| Long-term Reversal | -0.23*** | -0.18*** | -0.20*** | -0.25*** | -0.09*** | -0.17*** |
| Max | -0.63*** | -0.62*** | -0.62*** | -0.73*** | -0.86*** | -0.79*** |
| Momentum | -0.27*** | -0.34*** | -0.30*** | -0.23*** | -0.39*** | -0.31*** |
| Momentum and LT reversal | -0.12* | -0.32*** | -0.22*** | -0.25*** | -0.08 | -0.17*** |
| Momentum-Reversal | -0.12*** | -0.06 | -0.09** | -0.15*** | -0.02 | -0.09* |
| Price | 0.20*** | 0.20*** | 0.20*** | 0.26*** | 0.44*** | 0.35*** |
| Seasonality | 0.15*** | 0.16*** | 0.15*** | -0.02 | -0.11*** | -0.06*** |
| Short-term Reversal | 0.13*** | 0.24*** | 0.18*** | 0.16*** | 0.29*** | 0.23*** |
| Size | 0.05*** | -0.01 | 0.02 | 0.10*** | 0.05** | 0.07*** |
| Volume | -0.30*** | -0.33*** | -0.31*** | -0.69*** | -0.71*** | -0.70*** |
| Volume Trend | -0.10*** | -0.08** | -0.09*** | -0.10** | 0.07 | -0.02 |
| Volume Variance | -0.14*** | -0.40*** | -0.27*** | -0.23*** | -0.65*** | -0.44*** |
| Volume-Momentum | 0.10* | 0.05 | 0.08 | 0.10 | -0.13 | -0.01 |
| Volume/MV | -0.29*** | -0.37*** | -0.33*** | -0.71*** | -0.71*** | -0.71*** |

Panel C: Valuation Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | 0.00 | -0.02 | -0.01 | 0.17*** | 0.24*** | 0.20*** |
| Book-to-Market | 0.06* | -0.18*** | -0.06* | -0.03 | -0.26*** | -0.15*** |
| Cash Flow/MV | -0.08*** | -0.17*** | -0.12*** | -0.23*** | -0.44*** | -0.34*** |
| Dividend Yield | -0.27*** | -0.32*** | -0.29*** | -0.56*** | -0.49*** | -0.52*** |
| Earnings-to-Price | -0.10*** | -0.19*** | -0.15*** | -0.28*** | -0.53*** | -0.40*** |
| Enterprise Component of B/P | 0.13*** | -0.13*** | 0.00 | 0.19*** | 0.03 | 0.11*** |
| Enterprise Multiple | -0.19*** | -0.18*** | -0.18*** | -0.24*** | -0.34*** | -0.29*** |
| Leverage Component of B/P | 0.12*** | 0.07*** | 0.09*** | 0.26*** | 0.28*** | 0.27*** |
| Org. Capital | 0.00 | -0.01 | -0.01 | -0.11*** | 0.15*** | 0.02 |
| R&D/MV | -0.16*** | 0.05* | -0.05** | -0.06* | 0.40*** | 0.17*** |
| Sales/Price | 0.00 | -0.10*** | -0.05 | -0.12*** | -0.11* | -0.11*** |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Analyst Value | -0.08*** | -0.05 | -0.06** | 0.05 | -0.16*** | -0.05* |
| Book-to-Market | 0.08** | -0.17*** | -0.05 | 0.04 | 0.11*** | 0.07*** |
| Cash Flow/MV | -0.06* | -0.08*** | -0.07*** | -0.03 | -0.01 | -0.02 |
| Dividend Yield | -0.10*** | -0.17*** | -0.13*** | -0.12*** | -0.17*** | -0.15*** |
| Earnings-to-Price | -0.04 | -0.08*** | -0.06* | -0.04 | -0.07*** | -0.06* |
| Enterprise Component of B/P | 0.11*** | -0.21*** | -0.05* | -0.02 | 0.06** | 0.02 |
| Enterprise Multiple | -0.17*** | -0.14*** | -0.16*** | -0.13*** | -0.12*** | -0.13*** |
| Leverage Component of B/P | 0.02 | -0.05*** | -0.01 | -0.06*** | -0.01 | -0.04*** |
| Org. Capital | 0.02 | -0.09*** | -0.04* | 0.12*** | 0.01 | 0.06*** |
| R&D/MV | -0.18*** | -0.09*** | -0.13*** | -0.17*** | 0.02 | -0.07** |
| Sales/Price | 0.09*** | -0.12*** | -0.01 | 0.04 | 0.13*** | 0.09*** |

Panel D: Fundamental Anomalies

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | -0.14*** | -0.03** | -0.09*** | -0.11*** | 0.08*** | -0.02 |
| Age | 0.14*** | 0.23*** | 0.18*** | 0.01 | 0.26*** | 0.13*** |
| Asset Growth | -0.26*** | -0.25*** | -0.26*** | -0.25*** | -0.11*** | -0.18*** |
| Asset Turnover | -0.10*** | 0.00 | -0.05*** | -0.07** | 0.22*** | 0.07*** |
| Cash Flow Variance | -0.18*** | -0.10*** | -0.14*** | -0.15*** | -0.06 | -0.11*** |
| Earnings Consistency | -0.07 | 0.11*** | 0.02 | -0.02 | 0.32*** | 0.15*** |
| Forecast Dispersion | -0.42*** | -0.34*** | -0.38*** | -0.46*** | -0.45*** | -0.45*** |
| Gross Profitability | -0.20*** | 0.00 | -0.10*** | -0.20*** | 0.16*** | -0.02 |
| G-Score | -0.31*** | -0.24*** | -0.25*** | -0.35*** | -0.33*** | -0.29*** |
| F-Score | -0.10*** | -0.17*** | -0.14*** | -0.14*** | -0.22*** | -0.18*** |
| Herfindahl | -0.12*** | -0.26*** | -0.19*** | 0.20*** | -0.29*** | -0.05 |
| Investment | 0.02 | 0.02 | 0.02 | 0.04 | 0.01 | 0.02 |
| Leverage | 0.03 | -0.03*** | 0.00 | 0.08*** | -0.01 | 0.03 |
| M/B and Accruals | 0.06 | -0.22*** | -0.08*** | 0.06 | -0.24*** | -0.09** |
| NOA | 0.16*** | 0.02 | 0.09*** | 0.22*** | 0.18*** | 0.20*** |
| Operating Leverage | -0.17*** | 0.02 | -0.07*** | -0.16*** | 0.23*** | 0.04 |
| O-Score | -0.08*** | -0.02 | -0.05*** | -0.01 | 0.08*** | 0.04 |
| Pension Funding | 0.07** | 0.08* | 0.07*** | 0.09** | -0.05 | 0.02 |
| Percent Operating Accrual | -0.02 | -0.06*** | -0.04*** | 0.07*** | -0.01 | 0.03 |
| Percent Total Accrual | -0.12*** | -0.08*** | -0.10*** | -0.09*** | -0.01 | -0.05*** |
| Profit Margin | -0.03 | -0.12*** | -0.08*** | -0.05* | -0.47*** | -0.26*** |
| Profitability | -0.21*** | -0.05* | -0.13*** | -0.26*** | -0.21*** | -0.23*** |
| ROE | -0.09*** | 0.00 | -0.05* | -0.16*** | -0.28*** | -0.22*** |
| Sales Growth | 0.27*** | 0.23*** | 0.25*** | 0.28*** | 0.08*** | 0.18*** |
| Tax | -0.02 | -0.18*** | -0.10*** | -0.05 | 0.02 | -0.01 |
| Z-Score | -0.10*** | 0.10*** | 0.00 | 0.00 | 0.31*** | 0.15*** |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Factor | Large | Small | Average | Large | Small | Average |
| Accruals | -0.15*** | -0.05*** | -0.10*** | -0.18*** | -0.06*** | -0.12*** |
| Age | 0.06 | 0.11*** | 0.08*** | 0.09* | 0.13*** | 0.11*** |
| Asset Growth | -0.18*** | -0.25*** | -0.21*** | -0.28*** | -0.12*** | -0.20*** |
| Asset Turnover | -0.09*** | -0.07*** | -0.08*** | -0.08* | -0.07*** | -0.07*** |
| Cash Flow Variance | -0.15*** | -0.06** | -0.11*** | -0.09** | -0.18*** | -0.14*** |
| Earnings Consistency | 0.09** | 0.09*** | 0.09*** | 0.15*** | 0.12*** | 0.14*** |
| Forecast Dispersion | -0.39*** | -0.36*** | -0.37*** | -0.37*** | -0.28*** | -0.33*** |
| Gross Profitability | -0.20*** | -0.02 | -0.11*** | -0.15*** | -0.17*** | -0.16*** |
| G-Score | 0.01 | -0.33*** | -0.22*** | -0.17* | 0.02 | -0.07 |
| F-Score | -0.13*** | -0.13*** | -0.13*** | -0.02 | -0.15*** | -0.08*** |
| Herfindahl | -0.02 | -0.35*** | -0.18*** | 0.03 | 0.15*** | 0.09*** |
| Investment | -0.01 | 0.04*** | 0.02 | 0.04 | -0.02 | 0.01 |
| Leverage | -0.07*** | -0.06*** | -0.07*** | -0.07*** | 0.00 | -0.03* |
| M/B and Accruals | 0.02 | -0.21*** | -0.09*** | 0.05 | -0.02 | 0.01 |
| NOA | 0.23*** | -0.03 | 0.10*** | 0.09** | 0.03 | 0.06** |
| Operating Leverage | -0.18*** | -0.06*** | -0.12*** | -0.16*** | -0.04* | -0.10*** |
| O-Score | -0.12*** | -0.09*** | -0.10*** | -0.23*** | -0.15*** | -0.19*** |
| Pension Funding | -0.10*** | 0.18*** | 0.04 | 0.12*** | 0.03 | 0.08** |
| Percent Operating Accrual | -0.02 | -0.06*** | -0.04** | -0.03 | -0.05* | -0.04 |
| Percent Total Accrual | -0.12*** | -0.09*** | -0.10*** | -0.18*** | -0.01 | -0.10*** |
| Profit Margin | -0.07** | -0.01 | -0.04 | 0.10** | -0.10*** | 0.00 |
| Profitability | -0.22*** | 0.00 | -0.11*** | -0.11*** | -0.16*** | -0.14*** |
| ROE | -0.09** | 0.07** | -0.01 | 0.02 | -0.12*** | -0.05* |
| Sales Growth | 0.20*** | 0.24*** | 0.22*** | 0.25*** | 0.12*** | 0.18*** |
| Tax | 0.01 | -0.21*** | -0.10*** | -0.04 | 0.02 | -0.01 |
| Z-Score | -0.20*** | 0.02 | -0.09*** | -0.07* | -0.17*** | -0.12*** |

## Table 16: Global Factor Alphas

This table reports the global monthly alphas of factors using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just global returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Characteristic). All results are from August 1995 to December 2018. * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.17*** | 0.16*** | 0.13*** | 0.09* | 0.16*** |
| Change in Profit Margin | 0.07 | 0.10 | 0.05 | -0.01 | 0.06 |
| Chg. Forecast plus Accrual | 0.58*** | 0.63*** | 0.43*** | 0.63*** | 0.28*** |
| Dividend Initiation | -0.21 | -0.27** | -0.23* | -0.22 | -0.27* |
| Dividend Omission | 0.02 | 0.08 | 0.11 | -0.05 | 0.19 |
| Dividends | 0.17 | 0.08 | 0.01 | -0.24** | 0.36*** |
| Down Forecast | 0.42*** | 0.46*** | 0.28*** | 0.42*** | 0.25*** |
| Earnings Surprise | 0.18** | 0.23*** | 0.15** | 0.09 | 0.20*** |
| Growth in Inventory | 0.14* | 0.11* | 0.08 | 0.07 | 0.07 |
| Growth in LTNOA | 0.14 | 0.07 | 0.06 | -0.02 | 0.12 |
| IPO | 0.12 | 0.07 | 0.06 | -0.07 | 0.02 |
| IPO no R&D | 0.06 | 0.07 | 0.10 | 0.17 | -0.12 |
| Post Earnings Drift | 0.15 | 0.24*** | 0.20** | 0.42*** | 0.04 |
| R&D Increases | 0.14 | 0.10 | 0.06 | 0.07 | 0.12 |
| Repurchases | 0.33*** | 0.33*** | 0.26*** | 0.15 | 0.04 |
| Revenue Surprises | 0.22* | 0.32*** | 0.25*** | 0.22*** | 0.24*** |
| Share Issuance 1-Year | 0.38*** | 0.33*** | 0.28*** | 0.20*** | 0.28*** |
| Share Issuance 5-Year | 0.32*** | 0.30*** | 0.28*** | 0.27*** | 0.17** |
| Sustainable Growth | 0.13 | 0.06 | 0.03 | -0.04 | -0.07 |
| Total External Finance | 0.41*** | 0.38*** | 0.31*** | 0.14*** | 0.19*** |
| Up Forecast | 0.43*** | 0.47*** | 0.30*** | 0.43*** | 0.27*** |
| ΔCapex - ΔIndustry Capex | 0.11 | 0.08 | 0.04 | -0.03 | 0.23*** |
| ΔNoncurrent Op. Assets | -0.05 | -0.04 | -0.03 | 0.08 | 0.01 |
| ΔSales - ΔInventory | -0.02 | 0.06 | 0.08 | 0.11** | 0.16 |
| ΔSales - ΔSG&A | -0.06 | 0.00 | 0.03 | 0.03 | 0.15 |
| ΔWork. capital | 0.05 | 0.00 | -0.01 | -0.05 | -0.03 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.11** | 0.16*** | 0.21*** | 0.10* | 0.08 |
| Change in Profit Margin | 0.04 | 0.01 | 0.09 | -0.06 | -0.08 |
| Chg. Forecast plus Accrual | 0.71*** | 0.17 | 0.42*** | 0.33*** | 0.34*** |
| Dividend Initiation | -0.25* | -0.21 | -0.34*** | 0.05 | 0.04 |
| Dividend Omission | 0.14 | -0.08 | 0.43*** | -0.01 | 0.01 |
| Dividends | -0.36*** | 0.47*** | 0.00 | 0.11 | -0.03 |
| Down Forecast | 0.45*** | 0.22*** | 0.27*** | 0.18** | 0.16* |
| Earnings Surprise | 0.12 | 0.15** | 0.18** | 0.00 | 0.00 |
| Growth in Inventory | 0.02 | 0.09 | 0.01 | 0.13* | 0.10 |
| Growth in LTNOA | -0.15** | 0.34*** | -0.08 | 0.15 | 0.13 |
| IPO | -0.13 | 0.32*** | 0.00 | 0.10 | 0.09 |
| IPO no R&D | 0.12 | 0.05 | -0.03 | 0.08 | 0.12 |
| Post Earnings Drift | 0.43*** | -0.15 | 0.00 | 0.08 | 0.13 |
| R&D Increases | 0.07 | 0.13 | 0.11 | 0.19** | 0.17* |
| Repurchases | 0.16 | 0.43*** | 0.07 | 0.09 | 0.16 |
| Revenue Surprises | 0.31*** | 0.17* | 0.32*** | -0.05 | 0.00 |
| Share Issuance 1-Year | 0.13* | 0.45*** | 0.07*** | 0.34*** | 0.30*** |
| Share Issuance 5-Year | 0.19*** | 0.31*** | -0.07*** | 0.38*** | 0.37*** |
| Sustainable Growth | -0.14** | 0.09 | -0.13 | 0.18 | 0.17 |
| Total External Finance | 0.15*** | 0.35*** | 0.20*** | 0.33*** | 0.32*** |
| Up Forecast | 0.46*** | 0.26*** | 0.28*** | 0.20*** | 0.19** |
| ΔCapex - ΔIndustry Capex | -0.05 | 0.31*** | 0.11 | 0.01 | -0.03 |
| ΔNoncurrent Op. Assets | 0.02 | -0.11 | -0.03 | -0.10 | -0.08 |
| ΔSales - ΔInventory | 0.24*** | -0.11 | 0.31*** | -0.14 | -0.10 |
| ΔSales - ΔSG&A | 0.16** | -0.11 | 0.25** | -0.14 | -0.12 |
| ΔWork. capital | -0.08 | 0.03 | -0.08 | 0.11 | 0.08 |

Panel B: Market Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| 52-Week High | 0.76*** | 0.83*** | 0.22 | 0.43* | 0.14 |
| Age-Momentum | 0.21 | 0.37** | 0.15 | 0.28 | 0.37*** |
| Amihud's Measure | 0.04 | -0.05 | -0.08 | -0.09 | 0.23** |
| Beta | 0.59*** | 0.60*** | 0.38*** | 0.16 | 0.34** |
| Bid/Ask Spread | -0.33*** | -0.36*** | -0.34*** | -0.33*** | -0.21* |
| CoSkewness | 0.17*** | 0.16** | 0.09 | 0.17** | 0.13* |
| Idiosyncratic Risk | 0.56*** | 0.54*** | 0.38*** | 0.13 | 0.37*** |
| Industry momentum | 0.53*** | 0.55*** | 0.22 | 0.54*** | 0.10 |
| Lagged Momentum | 0.20 | 0.33* | -0.06 | 0.25 | -0.02 |
| Long-term Reversal | 0.09 | -0.03 | -0.13 | 0.19 | -0.26* |
| Max | 0.54*** | 0.51*** | 0.37*** | 0.10 | 0.41*** |
| Momentum | 0.56** | 0.61*** | 0.00 | 0.39 | -0.03 |
| Momentum and LT reversal | 0.32 | 0.38* | -0.01 | 0.27 | -0.01 |
| Momentum-Reversal | 0.29* | 0.19 | 0.28* | 0.29* | 0.21 |
| Price | -0.25 | -0.38*** | -0.20 | -0.35*** | 0.14 |
| Seasonality | -0.13* | -0.12 | -0.07 | -0.25*** | 0.10 |
| Short-term Reversal | -0.15 | -0.18 | -0.11 | -0.21 | -0.07 |
| Size | 0.04 | -0.03 | 0.02 | -0.02 | 0.03 |
| Volume | 0.10 | 0.00 | -0.06 | -0.19 | 0.35*** |
| Volume Trend | -0.08 | -0.19* | 0.02 | -0.05 | -0.01 |
| Volume Variance | 0.30*** | 0.23** | 0.16 | 0.04 | 0.40*** |
| Volume-Momentum | 0.02 | 0.18 | -0.06 | 0.08 | 0.16 |
| Volume/MV | 0.12 | 0.04 | -0.08 | -0.18 | 0.36*** |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| 52-Week High | 0.51** | 0.34* | 0.55** | -0.18 | -0.26 |
| Age-Momentum | 0.34 | -0.27 | 0.16 | -0.14 | -0.19 |
| Amihud's Measure | -0.16 | 0.07 | 0.12 | 0.26* | 0.14 |
| Beta | 0.10 | 0.76*** | 0.26 | 0.11 | 0.08 |
| Bid/Ask Spread | -0.36*** | -0.25** | -0.18* | -0.23** | -0.26** |
| CoSkewness | 0.18*** | 0.12 | 0.17** | 0.10 | 0.09 |
| Idiosyncratic Risk | 0.07 | 1.02*** | 0.12 | 0.17 | 0.15 |
| Industry momentum | 0.64*** | 0.02 | 0.54*** | 0.09 | 0.02 |
| Lagged Momentum | 0.38* | -0.40*** | 0.17 | -0.40** | -0.43** |
| Long-term Reversal | 0.04 | 0.12 | -0.16 | 0.07 | 0.02 |
| Max | 0.04 | 1.02*** | 0.13 | 0.24 | 0.21 |
| Momentum | 0.53** | -0.06 | 0.58** | -0.25 | -0.34 |
| Momentum and LT reversal | 0.29 | -0.01 | 0.03 | -0.34 | -0.37* |
| Momentum-Reversal | 0.25 | 0.51*** | 0.37** | 0.49*** | 0.48*** |
| Price | -0.44*** | 0.14 | -0.18 | 0.33** | 0.23 |
| Seasonality | -0.22*** | 0.03 | 0.02 | -0.15* | -0.18** |
| Short-term Reversal | -0.16 | 0.20 | -0.29 | -0.07 | -0.06 |
| Size | -0.02 | 0.05 | 0.13* | 0.23*** | 0.23*** |
| Volume | -0.34* | 0.47*** | -0.11 | 0.18 | 0.03 |
| Volume Trend | -0.17 | 0.26*** | -0.26** | 0.34*** | 0.34*** |
| Volume Variance | -0.05 | 0.45*** | 0.21* | 0.31** | 0.21 |
| Volume-Momentum | 0.18 | -0.46*** | 0.00 | -0.41* | -0.46** |
| Volume/MV | -0.32* | 0.37* | -0.11 | 0.09 | -0.08 |

Panel C: Valuation Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Analyst Value | 0.11 | 0.19* | 0.13 | 0.41*** | -0.04 |
| Book-to-Market | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cash Flow/MV | 0.55*** | 0.42*** | 0.34*** | 0.08 | 0.35*** |
| Dividend Yield | 0.39*** | 0.28*** | 0.19* | -0.09 | 0.38*** |
| Earnings-to-Price | 0.54*** | 0.44*** | 0.37*** | -0.05 | 0.48*** |
| Enterprise Component of B/P | 0.10 | -0.03 | -0.01 | 0.05 | -0.01 |
| Enterprise Multiple | 0.63*** | 0.57*** | 0.47*** | 0.32*** | 0.35*** |
| Leverage Component of B/P | 0.01 | 0.05 | 0.07 | 0.25*** | 0.00 |
| Org. Capital | 0.10 | 0.10 | 0.12* | 0.22*** | -0.05 |
| R&D/MV | 0.07 | 0.11 | 0.11 | 0.34*** | -0.26*** |
| Sales/Price | 0.30** | 0.13** | 0.10 | 0.06 | -0.03 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Analyst Value | 0.43*** | -0.28** | 0.17 | 0.02 | 0.06 |
| Book-to-Market | -0.17 | 0.56*** | -0.01 | 0.36** | 0.32* |
| Cash Flow/MV | 0.03 | 0.82*** | 0.46*** | 0.50*** | 0.44*** |
| Dividend Yield | -0.21 | 0.80*** | 0.18* | 0.29 | 0.21 |
| Earnings-to-Price | -0.06 | 0.96*** | 0.49*** | 0.43*** | 0.38*** |
| Enterprise Component of B/P | -0.07 | 0.32*** | -0.02 | 0.28*** | 0.24** |
| Enterprise Multiple | 0.33*** | 0.71*** | 0.52*** | 0.48*** | 0.48*** |
| Leverage Component of B/P | 0.29*** | -0.23*** | 0.09 | 0.08 | 0.09 |
| Org. Capital | 0.17*** | -0.02 | -0.06 | 0.16** | 0.17*** |
| R&D/MV | 0.36*** | -0.22** | -0.06 | 0.11 | 0.17 |
| Sales/Price | -0.09 | 0.51*** | 0.00 | 0.38*** | 0.34** |

Panel D: Fundamental Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Accruals | 0.23*** | 0.26*** | 0.22*** | 0.28*** | 0.02 |
| Age | -0.26** | -0.20** | -0.17* | 0.00 | -0.11 |
| Asset Growth | 0.23* | 0.15 | 0.09 | 0.00*** | -0.04 |
| Asset Turnover | 0.24*** | 0.29*** | 0.28*** | 0.35*** | -0.01 |
| Cash Flow Variance | -0.20 | -0.08 | -0.03 | 0.10 | -0.12 |
| Earnings Consistency | 0.01 | -0.03 | -0.07 | 0.14 | -0.34*** |
| Forecast Dispersion | 0.41*** | 0.49*** | 0.40*** | 0.27** | 0.19 |
| Gross Profitability | 0.33*** | 0.44*** | 0.41*** | 0.44*** | 0.00*** |
| G-Score | 0.53*** | 0.54*** | 0.48*** | 0.37*** | 0.41*** |
| F-Score | 0.30*** | 0.31*** | 0.23*** | 0.14** | 0.21*** |
| Herfindahl | -0.06 | -0.05 | 0.05 | 0.17 | -0.21 |
| Investment | 0.09 | 0.10* | 0.06 | 0.17*** | 0.06 |
| Leverage | 0.12* | 0.03 | 0.04 | 0.01 | 0.03 |
| M/B and Accruals | 0.38*** | 0.32*** | 0.35*** | 0.31*** | 0.28*** |
| NOA | 0.05 | 0.10 | 0.09 | 0.26*** | 0.08 |
| Operating Leverage | 0.14* | 0.17** | 0.15* | 0.18*** | -0.13** |
| O-Score | 0.08 | 0.14* | 0.14* | 0.13 | -0.01 |
| Pension Funding | 0.04 | 0.02 | 0.01 | -0.05 | 0.21 |
| Percent Operating Accrual | 0.25*** | 0.26*** | 0.19*** | 0.31*** | 0.03 |
| Percent Total Accrual | 0.12 | 0.11 | 0.07 | 0.15*** | -0.09 |
| Profit Margin | 0.22** | 0.25*** | 0.23** | -0.10 | 0.44*** |
| Profitability | 0.39*** | 0.46*** | 0.40*** | 0.14** | 0.34*** |
| ROE | 0.42*** | 0.48*** | 0.44*** | -0.00*** | 0.54*** |
| Sales Growth | -0.07 | 0.00 | 0.05 | 0.03 | 0.15 |
| Tax | -0.06 | -0.07 | -0.09 | 0.20*** | -0.24*** |
| Z-Score | -0.01 | 0.13** | 0.15** | 0.21*** | -0.05 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Accruals | 0.34*** | -0.14** | 0.17** | 0.25*** | 0.26*** |
| Age | 0.06 | -0.50*** | -0.11 | -0.19 | -0.18 |
| Asset Growth | -0.11* | 0.20 | -0.07 | 0.27** | 0.25* |
| Asset Turnover | 0.36*** | -0.09 | 0.13* | 0.19** | 0.22** |
| Cash Flow Variance | 0.12 | -0.43*** | -0.26*** | -0.16 | -0.13 |
| Earnings Consistency | 0.17 | -0.14 | 0.03 | 0.00 | 0.06 |
| Forecast Dispersion | 0.29** | 0.42*** | 0.11 | 0.06 | 0.16 |
| Gross Profitability | 0.55*** | -0.08 | 0.28*** | 0.18 | 0.25* |
| G-Score | 0.40*** | 0.46*** | 0.40*** | 0.15 | 0.09 |
| F-Score | 0.14** | 0.30*** | 0.26*** | 0.16** | 0.13* |
| Herfindahl | 0.10 | 0.08 | -0.39*** | 0.00 | 0.14 |
| Investment | 0.16*** | 0.03 | 0.15*** | -0.01 | -0.02 |
| Leverage | -0.01 | 0.15*** | 0.14** | 0.26*** | 0.25*** |
| M/B and Accruals | 0.28** | 0.48*** | 0.33*** | 0.46*** | 0.44*** |
| NOA | 0.23*** | -0.11 | 0.02 | -0.03 | -0.01 |
| Operating Leverage | 0.20** | -0.15** | 0.05 | 0.13 | 0.15 |
| O-Score | 0.24*** | -0.08 | 0.16* | 0.11 | 0.13 |
| Pension Funding | -0.08 | 0.08 | 0.05 | -0.08 | -0.18 |
| Percent Operating Accrual | 0.30*** | 0.13 | 0.27*** | 0.08 | 0.12 |
| Percent Total Accrual | 0.13* | -0.14* | 0.00 | 0.18** | 0.18** |
| Profit Margin | -0.02 | 0.45*** | 0.36*** | 0.05 | 0.03 |
| Profitability | 0.28*** | 0.27*** | 0.40*** | 0.25** | 0.26** |
| ROE | 0.14** | 0.51*** | 0.52*** | 0.19 | 0.18 |
| Sales Growth | 0.17* | -0.10 | 0.25** | -0.07 | -0.03 |
| Tax | 0.08 | -0.20** | -0.28*** | -0.03 | -0.04 |
| Z-Score | 0.37*** | -0.46*** | 0.17 | -0.02 | 0.03 |

## Table 17: U.S. Factor Alphas

This table reports the U.S. monthly alphas of factors using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just U.S. returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Char). All results are from August 1995 to December 2018. * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.21*** | 0.19*** | 0.17*** | 0.09 | 0.17** |
| Change in Profit Margin | -0.02 | 0.01 | 0.00 | -0.09 | -0.02 |
| Chg. Forecast plus Accrual | 0.21 | 0.27* | 0.16 | 0.17 | 0.15 |
| Dividend Initiation | -0.11 | -0.18 | -0.20 | -0.38** | -0.32* |
| Dividend Omission | -0.10 | -0.05 | -0.03 | 0.12 | -0.05 |
| Dividends | 0.15 | 0.05 | 0.00 | -0.23*** | 0.07 |
| Down Forecast | 0.11 | 0.18 | 0.06 | 0.06 | 0.08 |
| Earnings Surprise | 0.07 | 0.11 | 0.05 | -0.01 | 0.04 |
| Growth in Inventory | 0.07 | 0.05 | 0.02 | 0.05 | 0.13* |
| Growth in LTNOA | 0.26** | 0.20** | 0.15* | 0.07 | 0.24*** |
| IPO | 0.11 | 0.06 | 0.05 | -0.07 | -0.05 |
| IPO no R&D | 0.08 | 0.10 | 0.10 | 0.10 | -0.02 |
| Post Earnings Drift | 0.06 | 0.15* | 0.12 | 0.17* | 0.10 |
| R&D Increases | 0.21* | 0.18 | 0.16 | 0.11 | 0.20 |
| Repurchases | 0.31*** | 0.26*** | 0.24*** | 0.10 | 0.14* |
| Revenue Surprises | 0.09 | 0.17** | 0.15* | 0.16* | 0.11 |
| Share Issuance 1-Year | 0.48*** | 0.42*** | 0.39*** | 0.15** | 0.26*** |
| Share Issuance 5-Year | 0.35*** | 0.34*** | 0.33*** | 0.11* | 0.18*** |
| Sustainable Growth | 0.34*** | 0.25*** | 0.21*** | 0.12** | 0.24*** |
| Total External Finance | 0.27*** | 0.24*** | 0.21*** | -0.03 | 0.13 |
| Up Forecast | 0.15 | 0.21 | 0.09 | 0.09 | 0.10 |
| ΔCapex - ΔIndustry Capex | 0.12 | 0.09 | 0.06 | 0.00 | 0.16* |
| ΔNoncurrent Op. Assets | -0.01 | 0.02 | 0.00 | 0.15 | 0.02 |
| ΔSales - ΔInventory | -0.06 | 0.02 | 0.05 | 0.19*** | 0.02 |
| ΔSales - ΔSG&A | -0.06 | 0.00 | 0.02 | 0.12 | -0.05 |
| ΔWork. capital | 0.19** | 0.14* | 0.10 | 0.04 | 0.11 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.12* | 0.26*** | 0.17*** | 0.14* | 0.14* |
| Change in Profit Margin | 0.09 | 0.01 | -0.05 | -0.08 | -0.11 |
| Chg. Forecast plus Accrual | 0.31* | -0.01 | 0.11 | 0.05 | 0.04 |
| Dividend Initiation | -0.44*** | 0.02 | -0.42*** | -0.19 | -0.06 |
| Dividend Omission | 0.21** | -0.29*** | 0.10 | 0.02 | 0.03 |
| Dividends | -0.38*** | 0.54*** | -0.24** | -0.12 | -0.11 |
| Down Forecast | 0.21 | 0.04 | -0.05 | -0.08 | -0.11 |
| Earnings Surprise | 0.14 | 0.12 | -0.01 | -0.06 | -0.07 |
| Growth in Inventory | -0.04 | 0.05 | 0.04 | -0.03 | -0.07 |
| Growth in LTNOA | -0.02 | 0.41*** | 0.10 | 0.10 | 0.05 |
| IPO | -0.14 | 0.25* | -0.09 | 0.01 | 0.03 |
| IPO no R&D | 0.15 | -0.09 | 0.10 | 0.07 | 0.06 |
| Post Earnings Drift | 0.35*** | -0.08 | 0.00 | 0.03 | 0.03 |
| R&D Increases | 0.06 | 0.20 | 0.18 | 0.23* | 0.26* |
| Repurchases | 0.04 | 0.45*** | -0.01 | 0.16 | 0.20 |
| Revenue Surprises | 0.34*** | 0.14 | 0.10 | 0.05 | 0.06 |
| Share Issuance 1-Year | 0.14 | 0.54*** | 0.04 | 0.28** | 0.28* |
| Share Issuance 5-Year | 0.16** | 0.46*** | -0.04 | 0.24** | 0.26** |
| Sustainable Growth | 0.00 | 0.34*** | 0.22*** | 0.21* | 0.16 |
| Total External Finance | 0.01 | 0.38*** | 0.00 | 0.11 | 0.12 |
| Up Forecast | 0.22 | 0.07 | -0.02 | -0.06 | -0.09 |
| ΔCapex - ΔIndustry Capex | -0.05 | 0.33*** | 0.02 | 0.04 | -0.05 |
| ΔNoncurrent Op. Assets | 0.18 | -0.21 | 0.10 | -0.08 | -0.08 |
| ΔSales - ΔInventory | 0.31*** | -0.18 | 0.15 | 0.04 | 0.06 |
| ΔSales - ΔSG&A | 0.24*** | -0.14 | 0.08 | 0.00 | 0.04 |
| ΔWork. capital | -0.02 | 0.14 | 0.09 | 0.09 | 0.09 |

Panel B: Market Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| 52-Week High | 0.45* | 0.47* | 0.13 | 0.07 | 0.06 |
| Age-Momentum | 0.37 | 0.53** | 0.33 | 0.24 | 0.39* |
| Amihud's Measure | 0.09 | 0.01 | -0.02 | 0.01 | 0.05 |
| Beta | 0.54** | 0.50*** | 0.40*** | 0.14 | 0.37** |
| Bid/Ask Spread | 0.13 | 0.05 | 0.04 | 0.04 | 0.01 |
| CoSkewness | 0.17 | 0.16 | 0.11 | 0.12 | 0.10 |
| Idiosyncratic Risk | 0.65*** | 0.59*** | 0.49*** | 0.19 | 0.39*** |
| Industry momentum | 0.41 | 0.42* | 0.16 | 0.31 | 0.06 |
| Lagged Momentum | 0.13 | 0.24 | 0.04 | 0.09 | 0.10 |
| Long-term Reversal | 0.18 | 0.06 | 0.00 | 0.01 | 0.01 |
| Max | 0.83*** | 0.78*** | 0.68*** | 0.37*** | 0.56*** |
| Momentum | 0.17 | 0.19 | -0.18 | 0.02 | -0.21 |
| Momentum and LT reversal | 0.04 | 0.06 | -0.12 | -0.13 | -0.04 |
| Momentum-Reversal | 0.27 | 0.16 | 0.20 | 0.26 | 0.20 |
| Price | -0.08 | -0.19 | 0.05 | 0.05 | 0.01 |
| Seasonality | -0.07 | -0.06 | -0.06 | -0.11 | -0.02 |
| Short-term Reversal | 0.21 | 0.21 | 0.24 | 0.21 | 0.21 |
| Size | 0.10 | 0.03 | 0.06 | 0.03 | 0.05 |
| Volume | 0.34 | 0.27* | 0.20 | -0.08 | 0.20 |
| Volume Trend | 0.12 | 0.04 | 0.19* | 0.05 | 0.08 |
| Volume Variance | 0.36*** | 0.28*** | 0.22** | 0.04 | 0.24*** |
| Volume-Momentum | -0.02 | 0.14 | -0.04 | -0.12 | 0.06 |
| Volume/MV | 0.34 | 0.29* | 0.20 | -0.08 | 0.21 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| 52-Week High | 0.31 | 0.40* | 0.17 | -0.29 | -0.50** |
| Age-Momentum | 0.65*** | 0.22 | 0.29 | -0.04 | -0.13 |
| Amihud's Measure | -0.03 | 0.04 | 0.23** | 0.07 | -0.01 |
| Beta | 0.16 | 1.00*** | 0.09 | 0.16 | 0.18 |
| Bid/Ask Spread | -0.03 | 0.14 | 0.17 | 0.06 | 0.05 |
| CoSkewness | 0.17 | 0.14 | 0.20 | 0.03 | 0.10 |
| Idiosyncratic Risk | 0.13 | 1.20*** | -0.02 | 0.26 | 0.26 |
| Industry momentum | 0.48* | 0.00 | 0.52** | -0.22 | -0.25 |
| Lagged Momentum | 0.37* | -0.18 | 0.13 | -0.24 | -0.36 |
| Long-term Reversal | -0.20* | 0.16 | 0.14 | -0.03 | -0.11 |
| Max | 0.37** | 1.39*** | 0.25 | 0.47* | 0.48* |
| Momentum | 0.23 | -0.20 | 0.21 | -0.55** | -0.67*** |
| Momentum and LT reversal | 0.02 | 0.09 | -0.10 | -0.32 | -0.41* |
| Momentum-Reversal | -0.01 | 0.32* | 0.29* | 0.24 | 0.27 |
| Price | -0.22 | 0.06 | 0.06 | 0.51*** | 0.57*** |
| Seasonality | -0.10 | 0.05 | -0.14* | -0.09 | -0.12 |
| Short-term Reversal | 0.20 | 0.49** | 0.11 | 0.18 | 0.30 |
| Size | 0.04 | 0.07 | 0.25*** | 0.23*** | 0.22** |
| Volume | -0.14 | 0.81*** | -0.19 | -0.01 | -0.03 |
| Volume Trend | -0.16 | 0.26* | -0.02 | 0.42*** | 0.47*** |
| Volume Variance | 0.03 | 0.62*** | 0.12 | 0.13 | 0.09 |
| Volume-Momentum | 0.31 | -0.18 | -0.08 | -0.38 | -0.48 |
| Volume/MV | -0.09 | 0.79*** | -0.18 | -0.07 | -0.09 |

Panel C: Valuation Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Analyst Value | 0.24 | 0.33** | 0.29** | 0.53*** | 0.33** |
| Book-to-Market | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cash Flow/MV | 0.47** | 0.32*** | 0.30*** | 0.06 | 0.20** |
| Dividend Yield | 0.29 | 0.17 | 0.13 | -0.09 | 0.20* |
| Earnings-to-Price | 0.50** | 0.38*** | 0.35*** | 0.07 | 0.23** |
| Enterprise Component of B/P | 0.13 | 0.03 | 0.05 | 0.13** | 0.02 |
| Enterprise Multiple | 0.56*** | 0.45*** | 0.42*** | 0.18** | 0.22*** |
| Leverage Component of B/P | 0.02 | 0.09 | 0.11 | 0.27*** | 0.02 |
| Org. Capital | 0.11 | 0.12 | 0.14 | -0.02 | -0.05 |
| R&D/MV | 0.08 | 0.16 | 0.19 | 0.27*** | 0.05 |
| Sales/Price | 0.38* | 0.21** | 0.19* | -0.04 | -0.01 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Analyst Value | 0.63*** | -0.16 | 0.56*** | 0.26 | 0.25 |
| Book-to-Market | -0.38*** | 0.47*** | -0.05 | 0.13 | 0.13 |
| Cash Flow/MV | -0.11 | 0.76*** | 0.08 | 0.28 | 0.34 |
| Dividend Yield | -0.33** | 0.73*** | -0.13 | 0.03 | 0.04 |
| Earnings-to-Price | -0.03 | 0.86*** | 0.00 | 0.24 | 0.29 |
| Enterprise Component of B/P | -0.09 | 0.15* | 0.10 | 0.17 | 0.19 |
| Enterprise Multiple | 0.09 | 0.72*** | 0.17 | 0.39** | 0.45** |
| Leverage Component of B/P | 0.40*** | -0.37*** | 0.28** | 0.15 | 0.16 |
| Org. Capital | 0.06 | 0.13 | -0.10 | 0.15 | 0.24*** |
| R&D/MV | 0.38*** | -0.19 | 0.26* | 0.21 | 0.23 |
| Sales/Price | -0.20 | 0.65*** | 0.00 | 0.25 | 0.33 |

Panel D: Fundamental Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Accruals | 0.18 | 0.22** | 0.21** | 0.20** | 0.13 |
| Age | -0.14 | -0.08 | -0.07 | 0.06 | 0.06 |
| Asset Growth | 0.29*** | 0.21*** | 0.17** | 0.00 | 0.19** |
| Asset Turnover | 0.19 | 0.25*** | 0.25*** | 0.11 | -0.04 |
| Cash Flow Variance | -0.12 | 0.01 | 0.01 | 0.01 | 0.03 |
| Earnings Consistency | -0.12 | -0.16 | -0.15 | -0.05 | -0.12 |
| Forecast Dispersion | 0.34* | 0.35*** | 0.26* | -0.02 | 0.11 |
| Gross Profitability | 0.23 | 0.33*** | 0.34*** | 0.19** | 0.00 |
| G-Score | 0.66*** | 0.63*** | 0.59*** | 0.43*** | 0.48*** |
| F-Score | 0.21** | 0.21** | 0.19** | -0.03 | 0.13 |
| Herfindahl | -0.03 | -0.08 | -0.07 | 0.03 | 0.03 |
| Investment | 0.07 | 0.09 | 0.06 | 0.09 | 0.07 |
| Leverage | 0.23*** | 0.13*** | 0.12*** | 0.11** | 0.12*** |
| M/B and Accruals | 0.60*** | 0.50*** | 0.48*** | 0.53*** | 0.48*** |
| NOA | 0.07 | 0.14 | 0.12 | 0.29** | 0.15 |
| Operating Leverage | 0.11 | 0.13 | 0.14 | -0.07 | -0.18*** |
| O-Score | -0.14 | -0.06 | -0.02 | -0.02 | -0.17** |
| Pension Funding | -0.06 | -0.05 | -0.06 | 0.04 | -0.01 |
| Percent Operating Accrual | 0.18** | 0.15* | 0.14* | 0.22*** | 0.16** |
| Percent Total Accrual | 0.12 | 0.12 | 0.09 | 0.08 | 0.09 |
| Profit Margin | 0.13 | 0.13 | 0.12 | 0.01 | 0.17* |
| Profitability | 0.22 | 0.30*** | 0.27** | -0.02 | 0.05 |
| ROE | 0.27** | 0.31*** | 0.30*** | 0.00*** | 0.14 |
| Sales Growth | -0.05 | 0.02 | 0.03 | 0.14* | -0.02 |
| Tax | 0.06 | 0.04 | 0.02 | -0.05 | -0.09 |
| Z-Score | -0.20 | -0.04 | 0.00 | -0.01 | -0.18*** |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Accruals | 0.29*** | -0.11 | 0.24** | 0.23* | 0.23* |
| Age | 0.14 | -0.27* | 0.10 | -0.03 | -0.05 |
| Asset Growth | -0.10 | 0.31*** | 0.14 | 0.18 | 0.15 |
| Asset Turnover | 0.38*** | -0.05 | 0.15 | 0.19 | 0.26* |
| Cash Flow Variance | 0.28*** | -0.28** | -0.01 | -0.13 | -0.16 |
| Earnings Consistency | -0.10 | -0.20 | 0.17 | 0.00 | 0.06 |
| Forecast Dispersion | 0.16 | 0.61*** | -0.17 | 0.02 | 0.00 |
| Gross Profitability | 0.52*** | 0.02 | 0.18 | 0.26* | 0.30* |
| G-Score | 0.52*** | 0.51*** | 0.55*** | 0.32* | 0.10 |
| F-Score | 0.09 | 0.36*** | 0.00 | 0.08 | 0.09 |
| Herfindahl | -0.16 | 0.17 | -0.16 | -0.09 | -0.10 |
| Investment | 0.12 | -0.03 | 0.12 | 0.01 | -0.05 |
| Leverage | 0.05 | 0.22*** | 0.32*** | 0.23** | 0.22** |
| M/B and Accruals | 0.28 | 0.49*** | 0.45*** | 0.50*** | 0.51*** |
| NOA | 0.35*** | -0.15 | 0.17 | 0.03 | 0.01 |
| Operating Leverage | 0.16 | -0.02 | 0.02 | 0.14 | 0.21 |
| O-Score | 0.13 | -0.38*** | -0.05 | 0.01 | 0.04 |
| Pension Funding | -0.01 | -0.08 | -0.11 | -0.05 | -0.07 |
| Percent Operating Accrual | 0.10 | 0.12 | 0.24*** | 0.18** | 0.18** |
| Percent Total Accrual | 0.08 | -0.03 | 0.17* | 0.10 | 0.10 |
| Profit Margin | 0.00 | 0.36*** | -0.13 | -0.05 | -0.05 |
| Profitability | 0.31*** | 0.24*** | -0.02 | 0.10 | 0.20 |
| ROE | 0.23*** | 0.42*** | -0.10 | 0.11 | 0.16 |
| Sales Growth | 0.27*** | -0.19* | 0.11 | 0.00 | 0.03 |
| Tax | 0.01 | 0.05 | 0.00 | 0.02 | 0.02 |
| Z-Score | 0.36*** | -0.57*** | 0.05 | -0.01 | 0.02 |

## Table 18: Developed ex U.S. Factor Alphas

This table reports the Developed ex U.S. monthly alphas of factors using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just Developed ex U.S. returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Char). All results are from August 1995 to December 2018. * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.05 | 0.07 | 0.04 | 0.08 | 0.03 |
| Change in Profit Margin | 0.11 | 0.15* | 0.10 | 0.02 | 0.11 |
| Chg. Forecast plus Accrual | 0.37*** | 0.39*** | 0.21* | 0.38*** | 0.16 |
| Dividend Initiation | -0.09 | -0.22 | -0.13 | -0.13 | -0.12 |
| Dividend Omission | 0.11 | 0.25* | 0.24 | -0.11 | 0.35** |
| Dividends | 0.26** | 0.28*** | 0.25** | 0.13 | 0.26** |
| Down Forecast | 0.34*** | 0.35*** | 0.21*** | 0.34*** | 0.22*** |
| Earnings Surprise | 0.20** | 0.27*** | 0.19*** | 0.15* | 0.24*** |
| Growth in Inventory | 0.15 | 0.07 | 0.06 | 0.03 | 0.06 |
| Growth in LTNOA | 0.03 | -0.08 | -0.07 | -0.05 | -0.04 |
| IPO | 0.11 | 0.05 | 0.02 | -0.09 | 0.12 |
| IPO no R&D | 0.10 | 0.12 | 0.11 | 0.13 | 0.07 |
| Post Earnings Drift | 0.23* | 0.19 | 0.12 | 0.13 | 0.16 |
| R&D Increases | 0.14 | 0.10 | 0.09 | 0.08 | 0.14 |
| Repurchases | 0.20* | 0.12 | 0.05 | 0.02 | 0.06 |
| Revenue Surprises | 0.23 | 0.36*** | 0.22* | 0.33*** | 0.21 |
| Share Issuance 1-Year | 0.21*** | 0.15* | 0.12 | 0.22*** | 0.05 |
| Share Issuance 5-Year | 0.14 | 0.07 | 0.09 | 0.26*** | -0.03 |
| Sustainable Growth | 0.01 | -0.10 | -0.09 | -0.11** | -0.11 |
| Total External Finance | 0.34*** | 0.32*** | 0.25*** | 0.18*** | 0.17* |
| Up Forecast | 0.33*** | 0.34*** | 0.20*** | 0.33*** | 0.20*** |
| ΔCapex - ΔIndustry Capex | -0.12 | -0.16* | -0.13 | -0.24*** | 0.02 |
| ΔNoncurrent Op. Assets | -0.11 | -0.15 | -0.14 | -0.09 | -0.12 |
| ΔSales - ΔInventory | -0.08 | 0.06 | 0.09 | 0.07 | 0.12 |
| ΔSales - ΔSG&A | -0.05 | 0.08 | 0.11 | 0.05 | 0.15 |
| ΔWork. capital | 0.03 | -0.02 | 0.00 | -0.11* | 0.01 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.09 | -0.04 | 0.08 | -0.03 | -0.03 |
| Change in Profit Margin | -0.05 | 0.00 | 0.12 | -0.03 | -0.07 |
| Chg. Forecast plus Accrual | 0.33*** | 0.05 | 0.29*** | 0.17 | 0.17 |
| Dividend Initiation | 0.01 | 0.02 | -0.23 | 0.25 | 0.21 |
| Dividend Omission | 0.02 | 0.07 | 0.35*** | -0.18 | -0.04 |
| Dividends | 0.01 | 0.36*** | 0.22* | 0.11 | 0.08 |
| Down Forecast | 0.30*** | 0.19*** | 0.28*** | 0.17** | 0.14* |
| Earnings Surprise | 0.08 | 0.12 | 0.22*** | -0.01 | 0.03 |
| Growth in Inventory | 0.03 | 0.14 | 0.07 | 0.27*** | 0.20* |
| Growth in LTNOA | -0.07 | 0.13 | -0.09 | 0.21* | 0.12 |
| IPO | -0.02 | 0.35*** | 0.05 | 0.08 | 0.06 |
| IPO no R&D | 0.08 | 0.08 | 0.10 | 0.07 | 0.08 |
| Post Earnings Drift | 0.13 | 0.26** | 0.00 | 0.13 | 0.09 |
| R&D Increases | 0.18* | 0.21* | 0.15 | 0.22* | 0.20* |
| Repurchases | 0.04 | 0.30*** | 0.10 | 0.15 | 0.12 |
| Revenue Surprises | 0.28** | 0.13 | 0.34*** | -0.15 | -0.03 |
| Share Issuance 1-Year | 0.18** | 0.14 | 0.06 | 0.26*** | 0.22** |
| Share Issuance 5-Year | 0.16 | 0.03 | -0.06 | 0.38*** | 0.29*** |
| Sustainable Growth | -0.11 | -0.06 | -0.12 | 0.28* | 0.21 |
| Total External Finance | 0.12* | 0.11 | 0.28*** | 0.37*** | 0.31*** |
| Up Forecast | 0.29*** | 0.19*** | 0.27*** | 0.17** | 0.14* |
| ΔCapex - ΔIndustry Capex | -0.14 | 0.10 | -0.11 | -0.11 | -0.10 |
| ΔNoncurrent Op. Assets | -0.12 | -0.03 | -0.13 | -0.13 | -0.15 |
| ΔSales - ΔInventory | 0.07 | -0.09 | 0.09 | -0.35** | -0.24 |
| ΔSales - ΔSG&A | 0.08 | -0.05 | 0.12 | -0.32** | -0.21 |
| ΔWork. capital | -0.10 | -0.01 | -0.03 | 0.17* | 0.14 |

Panel B: Market Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| 52-Week High | 0.81*** | 0.94*** | 0.29* | 0.64*** | 0.18 |
| Age-Momentum | 0.06 | 0.24 | 0.06 | 0.20 | 0.18 |
| Amihud's Measure | 0.13* | 0.07 | 0.05 | -0.01 | 0.08 |
| Beta | 0.69*** | 0.75*** | 0.43*** | 0.43** | 0.37** |
| Bid/Ask Spread | -0.23*** | -0.28*** | -0.27*** | -0.27*** | -0.25*** |
| CoSkewness | 0.19*** | 0.21*** | 0.15** | 0.23*** | 0.14* |
| Idiosyncratic Risk | 0.54*** | 0.53*** | 0.35** | 0.25* | 0.39*** |
| Industry momentum | 0.47*** | 0.50*** | 0.20 | 0.50*** | 0.15 |
| Lagged Momentum | 0.29 | 0.45*** | 0.04 | 0.40** | 0.12 |
| Long-term Reversal | -0.01 | -0.19 | -0.28* | 0.10 | -0.33** |
| Max | 0.52*** | 0.49*** | 0.31** | 0.24 | 0.37*** |
| Momentum | 0.60*** | 0.70*** | 0.06 | 0.52** | -0.06 |
| Momentum and LT reversal | 0.38 | 0.40* | 0.00 | 0.46* | -0.01 |
| Momentum-Reversal | 0.22 | 0.11 | 0.22 | 0.22 | 0.15 |
| Price | -0.14 | -0.30*** | -0.11 | -0.30*** | 0.03 |
| Seasonality | 0.04 | 0.15 | 0.18* | -0.07 | 0.29*** |
| Short-term Reversal | -0.18 | -0.24 | -0.17 | -0.17 | 0.02 |
| Size | 0.09 | 0.00 | 0.04 | 0.02 | 0.03 |
| Volume | 0.19* | 0.16 | 0.15 | 0.15 | 0.21* |
| Volume Trend | -0.07 | -0.24** | -0.05 | -0.09 | -0.06 |
| Volume Variance | 0.32*** | 0.28*** | 0.21*** | 0.16** | 0.25*** |
| Volume-Momentum | -0.08 | 0.15 | -0.11 | 0.08 | 0.01 |
| Volume/MV | 0.17 | 0.16 | 0.10 | 0.15 | 0.18 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| 52-Week High | 0.39* | 0.36* | 0.78*** | -0.13 | -0.17 |
| Age-Momentum | -0.02 | -0.42*** | 0.08 | -0.25 | -0.31 |
| Amihud's Measure | 0.02 | 0.01 | 0.10 | 0.20*** | 0.19** |
| Beta | 0.16 | 0.60*** | 0.69*** | 0.02 | 0.09 |
| Bid/Ask Spread | -0.27*** | -0.27*** | -0.23*** | -0.17* | -0.19** |
| CoSkewness | 0.26*** | 0.09 | 0.18*** | 0.12 | 0.11 |
| Idiosyncratic Risk | 0.17 | 0.72*** | 0.42*** | 0.17 | 0.14 |
| Industry momentum | 0.52*** | 0.21 | 0.43*** | 0.07 | -0.03 |
| Lagged Momentum | 0.27 | -0.18 | 0.35* | -0.35* | -0.33* |
| Long-term Reversal | 0.22 | 0.06 | -0.18 | 0.21 | 0.08 |
| Max | 0.19 | 0.68*** | 0.40*** | 0.25 | 0.22 |
| Momentum | 0.34 | 0.06 | 0.61*** | -0.28 | -0.30 |
| Momentum and LT reversal | 0.32 | -0.03 | 0.26 | -0.20 | -0.31 |
| Momentum-Reversal | 0.36* | 0.46*** | 0.15 | 0.51*** | 0.49*** |
| Price | -0.08 | 0.15 | -0.18 | 0.31*** | 0.28** |
| Seasonality | 0.03 | 0.12 | 0.18** | -0.12 | -0.05 |
| Short-term Reversal | -0.07 | 0.00 | -0.26 | -0.07 | -0.11 |
| Size | 0.03 | 0.03 | 0.05 | 0.28*** | 0.29*** |
| Volume | 0.16 | 0.27** | 0.09 | 0.27** | 0.23* |
| Volume Trend | 0.08 | 0.21* | -0.22 | 0.39*** | 0.31* |
| Volume Variance | 0.13* | 0.25*** | 0.26*** | 0.29*** | 0.28*** |
| Volume-Momentum | -0.17 | -0.55*** | 0.02 | -0.64*** | -0.64*** |
| Volume/MV | 0.12 | 0.13 | 0.06 | 0.16 | 0.09 |

Panel C: Valuation Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Analyst Value | -0.01 | 0.03 | -0.04 | 0.28*** | -0.18 |
| Book-to-Market | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cash Flow/MV | 0.52*** | 0.42*** | 0.34*** | 0.04 | 0.34*** |
| Dividend Yield | 0.55*** | 0.48*** | 0.45*** | 0.10 | 0.53*** |
| Earnings-to-Price | 0.58*** | 0.53*** | 0.46*** | -0.01 | 0.54*** |
| Enterprise Component of B/P | 0.11 | -0.08* | -0.06 | -0.04 | -0.03 |
| Enterprise Multiple | 0.46*** | 0.43*** | 0.34*** | 0.24*** | 0.25*** |
| Leverage Component of B/P | 0.02 | 0.01 | 0.02 | 0.08 | 0.01 |
| Org. Capital | -0.07 | -0.12 | -0.09 | 0.11 | -0.23*** |
| R&D/MV | 0.05 | 0.01 | 0.01 | 0.22*** | -0.22*** |
| Sales/Price | 0.21 | 0.01 | 0.00 | 0.00 | -0.09 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Analyst Value | 0.16 | -0.20 | -0.04 | -0.03 | -0.06 |
| Book-to-Market | 0.17 | 0.55*** | 0.11 | 0.45*** | 0.41*** |
| Cash Flow/MV | 0.17 | 0.63*** | 0.51*** | 0.37*** | 0.42*** |
| Dividend Yield | 0.23 | 0.86*** | 0.55*** | 0.41*** | 0.47*** |
| Earnings-to-Price | 0.10 | 0.77*** | 0.63*** | 0.34** | 0.42*** |
| Enterprise Component of B/P | 0.07 | 0.38*** | -0.02 | 0.31** | 0.25* |
| Enterprise Multiple | 0.27*** | 0.40*** | 0.44*** | 0.28*** | 0.35*** |
| Leverage Component of B/P | 0.06 | 0.02 | 0.00 | 0.08 | 0.06 |
| Org. Capital | 0.07 | -0.16* | -0.18*** | 0.08 | 0.04 |
| R&D/MV | 0.12 | -0.11 | -0.06 | 0.18 | 0.15 |
| Sales/Price | 0.10 | 0.37*** | 0.05 | 0.35** | 0.32* |

Panel D: Fundamental Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Accruals | 0.16* | 0.17** | 0.12 | 0.12* | 0.02 |
| Age | -0.22* | -0.17 | -0.15 | 0.06 | -0.25*** |
| Asset Growth | 0.22 | 0.08 | 0.04 | 0.00 | 0.00 |
| Asset Turnover | 0.10 | 0.13 | 0.10 | 0.19*** | -0.09* |
| Cash Flow Variance | -0.10 | -0.02 | 0.05 | 0.16* | 0.03 |
| Earnings Consistency | -0.27** | -0.36*** | -0.33*** | -0.17 | -0.35*** |
| Forecast Dispersion | 0.31*** | 0.33*** | 0.20* | 0.19 | 0.22* |
| Gross Profitability | 0.20* | 0.30*** | 0.25*** | 0.34*** | 0.00 |
| G-Score | 0.35 | 0.43* | 0.39 | 0.25 | 0.40 |
| F-Score | 0.25*** | 0.29*** | 0.19*** | 0.20*** | 0.10 |
| Herfindahl | -0.37* | -0.58*** | -0.47*** | -0.11 | -0.47*** |
| Investment | 0.11 | 0.13* | 0.08 | 0.13* | 0.09 |
| Leverage | 0.13* | 0.02 | 0.02 | 0.02 | 0.02 |
| M/B and Accruals | 0.32* | 0.26 | 0.24 | 0.13 | 0.11 |
| NOA | -0.03 | -0.03 | -0.03 | 0.01 | -0.04 |
| Operating Leverage | 0.14 | 0.16* | 0.12 | 0.20** | -0.09 |
| O-Score | 0.17* | 0.23*** | 0.18* | 0.13 | 0.11 |
| Pension Funding | 0.10 | 0.07 | 0.07 | -0.02 | 0.20* |
| Percent Operating Accrual | 0.01 | 0.00 | -0.05 | 0.07 | -0.15** |
| Percent Total Accrual | 0.03 | -0.03 | -0.04 | 0.02 | -0.14 |
| Profit Margin | 0.28** | 0.39*** | 0.32*** | 0.01 | 0.46*** |
| Profitability | 0.48*** | 0.60*** | 0.52*** | 0.29*** | 0.48*** |
| ROE | 0.42*** | 0.56*** | 0.49*** | 0.00*** | 0.57*** |
| Sales Growth | -0.11 | 0.02 | 0.11 | -0.01 | 0.18 |
| Tax | -0.24* | -0.32*** | -0.32*** | 0.10 | -0.47*** |
| Z-Score | 0.04 | 0.20*** | 0.16** | 0.19*** | 0.03 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Accruals | 0.11 | -0.14* | 0.15* | 0.18* | 0.18** |
| Age | -0.03 | -0.46*** | -0.18 | -0.16 | -0.15 |
| Asset Growth | 0.00 | 0.09 | 0.06 | 0.48*** | 0.37** |
| Asset Turnover | 0.08 | -0.18*** | 0.06 | 0.04 | 0.05 |
| Cash Flow Variance | 0.05 | -0.23* | -0.14 | 0.05 | 0.01 |
| Earnings Consistency | -0.08 | -0.25** | -0.35*** | -0.10 | -0.14 |
| Forecast Dispersion | 0.03 | 0.30*** | 0.22* | 0.09 | 0.07 |
| Gross Profitability | 0.17 | -0.16** | 0.22* | 0.06 | 0.09 |
| G-Score | 0.21 | 0.32 | 0.44* | 0.25 | 0.35 |
| F-Score | 0.09 | 0.08 | 0.25*** | 0.06 | 0.04 |
| Herfindahl | -0.18 | -0.21 | -0.60*** | 0.13 | -0.05 |
| Investment | 0.14* | 0.13* | 0.15** | -0.05 | -0.02 |
| Leverage | 0.05 | 0.12*** | 0.08 | 0.29*** | 0.28*** |
| M/B and Accruals | 0.19 | 0.17 | 0.30* | 0.36** | 0.38** |
| NOA | -0.02 | -0.04 | -0.04 | -0.08 | -0.08 |
| Operating Leverage | 0.09 | -0.17** | 0.10 | 0.09 | 0.11 |
| O-Score | 0.12 | 0.04 | 0.21** | 0.11 | 0.17 |
| Pension Funding | 0.07 | 0.08 | 0.28** | 0.14 | 0.09 |
| Percent Operating Accrual | 0.04 | -0.04 | 0.01 | -0.11 | -0.06 |
| Percent Total Accrual | 0.01 | -0.17* | -0.03 | 0.18* | 0.15 |
| Profit Margin | 0.01 | 0.33*** | 0.42*** | -0.05 | 0.02 |
| Profitability | 0.23** | 0.23*** | 0.57*** | 0.22* | 0.32** |
| ROE | -0.02 | 0.36*** | 0.57*** | -0.02 | 0.11 |
| Sales Growth | 0.02 | -0.03 | 0.06 | -0.26 | -0.14 |
| Tax | -0.01 | -0.34*** | -0.39*** | -0.05 | -0.17 |
| Z-Score | 0.05 | -0.38*** | 0.14 | -0.08 | -0.02 |

## Table 19: Emerging Market Factor Alphas

This table reports the Emerging Market monthly alphas of factors using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just Emerging Market returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Char). All results are from August 1995 to December 2018. * represents significance at a 0.10 level, ** at a 0.05 level, and *** at a 0.01 level.

Panel A: Event Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.30** | 0.32*** | 0.36*** | 0.12 | 0.37*** |
| Change in Profit Margin | 0.03 | 0.06 | 0.06 | -0.02 | -0.01 |
| Chg. Forecast plus Accrual | 1.03*** | 1.03*** | 0.86*** | 1.19*** | 0.89*** |
| Dividend Initiation | 0.01 | 0.03 | 0.10 | 0.15 | 0.05 |
| Dividend Omission | -0.20 | -0.17 | -0.18 | 0.06 | -0.09 |
| Dividends | 0.38** | 0.32* | 0.23 | 0.10 | 0.21 |
| Down Forecast | 0.60*** | 0.60*** | 0.51*** | 0.56*** | 0.57*** |
| Earnings Surprise | 0.19 | 0.32** | 0.34** | 0.23 | 0.38** |
| Growth in Inventory | 0.12 | 0.12 | 0.12 | 0.06 | 0.19 |
| Growth in LTNOA | 0.33* | 0.39** | 0.41*** | 0.17 | 0.53*** |
| IPO | 0.26 | 0.32* | 0.30 | 0.16 | 0.34* |
| IPO no R&D | 0.14 | 0.16 | 0.14 | 0.16 | 0.16 |
| Post Earnings Drift | 0.27** | 0.35*** | 0.34*** | 0.29** | 0.34*** |
| R&D Increases | 0.47** | 0.60*** | 0.52** | 0.47** | 0.47** |
| Repurchases | -0.01 | -0.12 | -0.13 | -0.12 | -0.24 |
| Revenue Surprises | -0.03 | 0.10 | 0.15 | 0.08 | 0.15 |
| Share Issuance 1-Year | 0.32* | 0.26 | 0.17 | 0.29* | 0.15 |
| Share Issuance 5-Year | 0.43*** | 0.37** | 0.31* | 0.30* | 0.23 |
| Sustainable Growth | 0.15 | 0.00 | -0.01 | -0.13 | -0.01 |
| Total External Finance | 0.42*** | 0.31*** | 0.22* | 0.22** | 0.18 |
| Up Forecast | 0.61*** | 0.62*** | 0.52*** | 0.58*** | 0.58*** |
| ΔCapex - ΔIndustry Capex | 0.12 | 0.07 | 0.07 | -0.03 | 0.21* |
| ΔNoncurrent Op. Assets | 0.04 | 0.18 | 0.22 | 0.07 | 0.31*** |
| ΔSales - ΔInventory | -0.29 | -0.16 | -0.14 | -0.23** | -0.22 |
| ΔSales - ΔSG&A | -0.31* | -0.18 | -0.14 | -0.21** | -0.18 |
| ΔWork. capital | 0.00 | -0.13 | -0.15 | -0.09 | -0.12 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Change in Asset Turnover | 0.13 | 0.42*** | 0.26** | 0.17 | 0.15 |
| Change in Profit Margin | -0.08 | -0.03 | 0.22* | -0.10 | -0.21 |
| Chg. Forecast plus Accrual | 1.17*** | 0.90*** | 0.48*** | 1.05*** | 1.15*** |
| Dividend Initiation | 0.18 | 0.05 | 0.15 | 0.18 | 0.28 |
| Dividend Omission | -0.03 | -0.02 | -0.30* | -0.07 | -0.10 |
| Dividends | 0.25 | 0.18 | 0.51*** | 0.25 | 0.20 |
| Down Forecast | 0.53*** | 0.58*** | 0.33*** | 0.37*** | 0.50*** |
| Earnings Surprise | 0.12 | 0.30* | 0.45*** | 0.02 | -0.10 |
| Growth in Inventory | -0.07 | 0.20 | 0.06 | 0.01 | -0.01 |
| Growth in LTNOA | -0.03 | 0.59*** | 0.09 | 0.09 | 0.12 |
| IPO | 0.15 | 0.47*** | 0.07 | 0.12 | 0.23 |
| IPO no R&D | 0.19 | 0.22 | 0.17 | 0.16 | 0.11 |
| Post Earnings Drift | 0.33** | 0.26* | 0.00 | 0.34*** | 0.46*** |
| R&D Increases | 0.41 | 0.25 | 0.00 | 0.31 | 0.31 |
| Repurchases | 0.14 | -0.11 | 0.30** | 0.02 | 0.11 |
| Revenue Surprises | 0.07 | 0.13 | 0.26* | -0.12 | -0.08 |
| Share Issuance 1-Year | 0.29 | 0.01 | 0.04 | 0.22 | 0.10 |
| Share Issuance 5-Year | 0.29 | 0.13 | -0.04 | 0.38** | 0.33* |
| Sustainable Growth | -0.20 | -0.02 | -0.20 | 0.18 | 0.14 |
| Total External Finance | 0.24* | 0.20 | 0.30*** | 0.31** | 0.29* |
| Up Forecast | 0.55*** | 0.59*** | 0.33*** | 0.40*** | 0.55*** |
| ΔCapex - ΔIndustry Capex | 0.04 | 0.26** | 0.10 | 0.07 | -0.07 |
| ΔNoncurrent Op. Assets | -0.12 | 0.23 | 0.04 | -0.04 | -0.01 |
| ΔSales - ΔInventory | -0.10 | -0.22 | 0.01 | -0.41** | -0.34* |
| ΔSales - ΔSG&A | -0.08 | -0.19 | 0.06 | -0.33* | -0.28 |
| ΔWork. capital | -0.07 | -0.13 | -0.15 | 0.11 | 0.09 |

Panel B: Market Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| 52-Week High | 0.50* | 0.55** | 0.03 | 0.49* | -0.05 |
| Age-Momentum | 0.11 | 0.35* | 0.11 | 0.39* | 0.09 |
| Amihud's Measure | 0.41* | 0.43* | 0.47** | 0.18 | 0.54*** |
| Beta | 0.18 | 0.26 | 0.19 | 0.10 | 0.14 |
| Bid/Ask Spread | -0.28 | -0.31 | -0.25 | -0.31 | -0.15 |
| CoSkewness | 0.28** | 0.33*** | 0.37*** | 0.29** | 0.35*** |
| Idiosyncratic Risk | 0.17 | 0.22 | 0.16 | 0.07 | 0.22 |
| Industry momentum | 0.19 | 0.15 | -0.01 | 0.24 | -0.03 |
| Lagged Momentum | 0.25 | 0.39* | -0.02 | 0.38* | -0.02 |
| Long-term Reversal | 0.69*** | 0.44** | 0.32 | 0.48*** | 0.40** |
| Max | 0.33** | 0.33** | 0.28* | 0.23 | 0.29* |
| Momentum | 0.41 | 0.44 | 0.01 | 0.34 | -0.07 |
| Momentum and LT reversal | 0.07 | 0.01 | -0.32 | -0.10 | -0.34 |
| Momentum-Reversal | 0.48** | 0.33 | 0.38* | 0.40* | 0.40* |
| Price | -0.19 | -0.22 | -0.07 | 0.13 | 0.25 |
| Seasonality | -0.19 | -0.16 | -0.08 | -0.24* | -0.09 |
| Short-term Reversal | -0.05 | -0.09 | 0.03 | -0.05 | 0.13 |
| Size | 0.00 | -0.03 | -0.05 | -0.04 | -0.03 |
| Volume | 0.49** | 0.48** | 0.49** | 0.24 | 0.62*** |
| Volume Trend | 0.04 | -0.13 | -0.01 | 0.05 | 0.10 |
| Volume Variance | 0.60*** | 0.68*** | 0.62*** | 0.31 | 0.69*** |
| Volume-Momentum | -0.03 | 0.20 | -0.11 | 0.16 | -0.15 |
| Volume/MV | 0.47* | 0.52** | 0.47** | 0.21 | 0.56*** |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| 52-Week High | 0.38 | 0.08 | 0.05 | -0.09 | -0.28 |
| Age-Momentum | 0.01 | -0.28 | -0.11 | -0.20 | -0.24 |
| Amihud's Measure | 0.07 | 0.59*** | 0.24 | 0.45* | 0.32 |
| Beta | -0.10 | 0.00 | 0.04 | 0.01 | 0.02 |
| Bid/Ask Spread | -0.42* | -0.23 | -0.36** | -0.13 | -0.30 |
| CoSkewness | 0.19 | 0.40*** | 0.17 | 0.24 | 0.21 |
| Idiosyncratic Risk | 0.14 | 0.38** | 0.00 | -0.21 | -0.16 |
| Industry momentum | 0.15 | -0.11 | 0.11 | 0.08 | -0.14 |
| Lagged Momentum | 0.21 | -0.07 | -0.04 | -0.23 | -0.42* |
| Long-term Reversal | 0.72*** | 0.78*** | 0.33 | 0.68*** | 0.64*** |
| Max | 0.26 | 0.33** | 0.23 | 0.07 | 0.10 |
| Momentum | 0.24 | 0.05 | -0.09 | -0.05 | -0.20 |
| Momentum and LT reversal | -0.31 | -0.30 | -0.10 | -0.55 | -0.91** |
| Momentum-Reversal | 0.67*** | 0.72*** | 0.54*** | 0.69*** | 0.68*** |
| Price | 0.14 | 0.19 | -0.04 | 0.35 | 0.15 |
| Seasonality | -0.19 | 0.01 | -0.04 | -0.17 | -0.12 |
| Short-term Reversal | 0.00 | 0.05 | 0.11 | -0.09 | 0.06 |
| Size | 0.00 | -0.02 | 0.14 | 0.11 | 0.08 |
| Volume | 0.20 | 0.70*** | 0.34 | 0.36 | 0.25 |
| Volume Trend | 0.29 | 0.16 | -0.06 | 0.37* | 0.28 |
| Volume Variance | 0.19 | 0.77*** | 0.65*** | 0.40 | 0.24 |
| Volume-Momentum | -0.09 | -0.48** | -0.19 | -0.53** | -0.62** |
| Volume/MV | 0.09 | 0.59*** | 0.28 | 0.19 | 0.10 |

Panel C: Valuation Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Analyst Value | 0.10 | 0.24 | 0.25 | 0.22 | 0.16 |
| Book-to-Market | 0.39* | 0.00 | 0.00 | 0.00 | 0.00 |
| Cash Flow/MV | 0.61*** | 0.29*** | 0.25** | 0.12 | 0.14 |
| Dividend Yield | 0.51*** | 0.33** | 0.31** | 0.10 | 0.38*** |
| Earnings-to-Price | 0.51*** | 0.25* | 0.25* | 0.02 | 0.19 |
| Enterprise Component of B/P | 0.28* | 0.00 | -0.03 | 0.00 | -0.02 |
| Enterprise Multiple | 0.54*** | 0.35*** | 0.23* | 0.30** | 0.23 |
| Leverage Component of B/P | 0.10 | 0.14 | 0.12 | 0.14 | 0.12 |
| Org. Capital | 0.34** | 0.22 | 0.16 | 0.07 | -0.02 |
| R&D/MV | 0.05 | 0.00 | -0.04 | 0.14 | -0.22 |
| Sales/Price | 0.56*** | 0.27** | 0.20* | 0.13 | 0.08 |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Analyst Value | -0.06 | 0.05 | -0.05 | 0.03 | 0.04 |
| Book-to-Market | 0.55*** | 0.49*** | 0.53*** | 0.46** | 0.48** |
| Cash Flow/MV | 0.57*** | 0.53*** | 0.62*** | 0.55*** | 0.50** |
| Dividend Yield | 0.37* | 0.63*** | 0.53*** | 0.44** | 0.38* |
| Earnings-to-Price | 0.38** | 0.49*** | 0.68*** | 0.42** | 0.31 |
| Enterprise Component of B/P | 0.41*** | 0.31** | 0.37*** | 0.32* | 0.33* |
| Enterprise Multiple | 0.60*** | 0.41*** | 0.60*** | 0.48*** | 0.44*** |
| Leverage Component of B/P | 0.08 | 0.02 | 0.07 | -0.01 | 0.01 |
| Org. Capital | 0.20 | 0.29* | 0.18 | 0.01 | 0.14 |
| R&D/MV | 0.29 | -0.20 | 0.17 | 0.26 | 0.22 |
| Sales/Price | 0.54*** | 0.49*** | 0.48*** | 0.49*** | 0.48** |

Panel D: Fundamental Anomalies

| Factor | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Accruals | 0.12 | 0.02 | -0.06 | 0.10 | -0.19 |
| Age | -0.33* | -0.40** | -0.42** | -0.15 | -0.45** |
| Asset Growth | 0.35* | 0.22 | 0.19 | 0.00 | 0.22 |
| Asset Turnover | 0.51*** | 0.62*** | 0.54*** | 0.35*** | 0.34** |
| Cash Flow Variance | -0.19 | 0.03 | 0.06 | 0.04 | -0.02 |
| Earnings Consistency | 0.01 | -0.04 | -0.05 | 0.06 | -0.08 |
| Forecast Dispersion | 0.23 | 0.31* | 0.27 | 0.32* | 0.29 |
| Gross Profitability | 0.38*** | 0.45*** | 0.34** | 0.36** | 0.00 |
| G-Score | 0.39 | 0.57 | 0.64 | 0.58 | 0.71* |
| F-Score | 0.30** | 0.36*** | 0.33*** | 0.23* | 0.32*** |
| Herfindahl | -0.35 | -0.27 | -0.13 | -0.13 | 0.03 |
| Investment | 0.11 | 0.14 | 0.10 | 0.13 | 0.09 |
| Leverage | 0.03 | -0.07 | -0.06 | -0.02 | -0.05 |
| M/B and Accruals | 0.11 | -0.16 | -0.16 | -0.32 | -0.21 |
| NOA | 0.15 | 0.28** | 0.30** | 0.17 | 0.39*** |
| Operating Leverage | 0.36*** | 0.40*** | 0.30** | 0.28* | 0.06 |
| O-Score | 0.18 | 0.12 | 0.07 | 0.24 | -0.08 |
| Pension Funding | 0.22 | 0.26 | 0.18 | 0.16 | 0.22 |
| Percent Operating Accrual | 0.34* | 0.31* | 0.21 | 0.27 | 0.26 |
| Percent Total Accrual | 0.16 | 0.00 | -0.11 | 0.05 | -0.21 |
| Profit Margin | -0.02 | 0.09 | 0.15 | -0.03 | 0.22 |
| Profitability | 0.41*** | 0.55*** | 0.52*** | 0.44*** | 0.37*** |
| ROE | 0.23 | 0.44*** | 0.46*** | 0.00*** | 0.40*** |
| Sales Growth | -0.35 | -0.15 | -0.04 | -0.10 | -0.02 |
| Tax | 0.13 | 0.20 | 0.12 | 0.04 | 0.14 |
| Z-Score | 0.13 | 0.37*** | 0.33*** | 0.33*** | 0.22** |

| Factor | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Accruals | 0.15 | -0.23* | 0.07 | 0.20 | 0.21 |
| Age | -0.10 | -0.52*** | -0.33** | -0.30 | -0.41* |
| Asset Growth | -0.09 | 0.20 | -0.03 | 0.29 | 0.29 |
| Asset Turnover | 0.37** | 0.44*** | 0.37*** | 0.24 | 0.33* |
| Cash Flow Variance | -0.35** | -0.25 | -0.47*** | -0.32* | -0.30 |
| Earnings Consistency | 0.13 | 0.00 | -0.10 | 0.06 | 0.33 |
| Forecast Dispersion | 0.12 | -0.01 | 0.27 | 0.17 | -0.09 |
| Gross Profitability | 0.35** | 0.04 | 0.24 | 0.11 | 0.20 |
| G-Score | 0.39 | 0.21 | 0.52 | -0.08 | 0.65 |
| F-Score | 0.14 | 0.38*** | 0.26** | 0.06 | -0.02 |
| Herfindahl | -0.10 | -0.13 | 0.08 | 0.11 | 0.11 |
| Investment | 0.17 | 0.11 | 0.11 | 0.01 | -0.06 |
| Leverage | 0.07 | 0.05 | 0.22** | 0.24** | 0.23* |
| M/B and Accruals | 0.17 | 0.29 | 0.09 | 0.06 | -0.01 |
| NOA | 0.03 | 0.36*** | 0.10 | 0.06 | 0.13 |
| Operating Leverage | 0.31* | 0.07 | 0.22 | 0.22 | 0.21 |
| O-Score | 0.36** | -0.14 | 0.19 | 0.05 | 0.02 |
| Pension Funding | 0.01 | -0.04 | -0.04 | 0.04 | 0.08 |
| Percent Operating Accrual | 0.39** | 0.45*** | 0.17 | 0.21 | 0.34* |
| Percent Total Accrual | 0.17 | -0.16 | 0.07 | 0.16 | 0.21 |
| Profit Margin | -0.18 | 0.14 | 0.13 | -0.12 | -0.07 |
| Profitability | 0.31*** | 0.16* | 0.38*** | 0.26* | 0.26 |
| ROE | -0.06 | 0.25* | 0.32** | 0.03 | 0.01 |
| Sales Growth | -0.09 | -0.07 | 0.05 | -0.19 | -0.22 |
| Tax | -0.03 | 0.02 | -0.04 | -0.03 | 0.03 |
| Z-Score | 0.05 | -0.04 | -0.07 | -0.01 | 0.02 |

## Table 20: Number of Significant Factor Alphas

This table reports the regional monthly alphas of factors using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just region returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Characteristic). All results are from August 1995 to December 2018.

Panel A: Global

| | No Control | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|---|
| + Significant at 0.10 level | 22 | 39 | 44 | 34 | 35 | 31 |
| + Significant at 0.05 level | 18 | 33 | 38 | 29 | 32 | 30 |
| + Significant at 0.01 level | 17 | 29 | 32 | 25 | 27 | 27 |
| - Significant at 0.10 level | 2 | 3 | 5 | 3 | 5 | 7 |
| - Significant at 0.05 level | 1 | 2 | 4 | 1 | 5 | 4 |
| - Significant at 0.01 level | 1 | 1 | 2 | 1 | 4 | 3 |

| | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| + Significant at 0.10 level | 38 | 37 | 36 | 30 | 26 |
| + Significant at 0.05 level | 34 | 34 | 31 | 27 | 20 |
| + Significant at 0.01 level | 25 | 33 | 22 | 16 | 14 |
| - Significant at 0.10 level | 10 | 13 | 7 | 4 | 5 |
| - Significant at 0.05 level | 6 | 12 | 6 | 2 | 4 |
| - Significant at 0.01 level | 4 | 6 | 5 | 0 | 0 |

Panel B: United States

| | No Control | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|---|
| + Significant at 0.10 level | 13 | 26 | 37 | 30 | 21 | 24 |
| + Significant at 0.05 level | 5 | 22 | 29 | 24 | 17 | 18 |
| + Significant at 0.01 level | 5 | 14 | 22 | 18 | 9 | 11 |
| - Significant at 0.10 level | 0 | 0 | 0 | 0 | 2 | 4 |
| - Significant at 0.05 level | 0 | 0 | 0 | 0 | 2 | 3 |
| - Significant at 0.01 level | 0 | 0 | 0 | 0 | 1 | 2 |

| | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| + Significant at 0.10 level | 25 | 36 | 15 | 16 | 16 |
| + Significant at 0.05 level | 21 | 31 | 12 | 9 | 9 |
| + Significant at 0.01 level | 18 | 30 | 8 | 4 | 4 |
| - Significant at 0.10 level | 5 | 7 | 3 | 1 | 3 |
| - Significant at 0.05 level | 4 | 5 | 2 | 1 | 2 |
| - Significant at 0.01 level | 3 | 4 | 1 | 0 | 1 |

Panel C: Developed ex U.S.

| | No Control | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|---|
| + Significant at 0.10 level | 21 | 33 | 36 | 26 | 30 | 22 |
| + Significant at 0.05 level | 15 | 24 | 29 | 20 | 24 | 17 |
| + Significant at 0.01 level | 11 | 21 | 28 | 15 | 19 | 14 |
| - Significant at 0.10 level | 4 | 5 | 8 | 5 | 5 | 10 |
| - Significant at 0.05 level | 3 | 2 | 6 | 4 | 4 | 9 |
| - Significant at 0.01 level | 1 | 1 | 5 | 4 | 3 | 7 |

| | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| + Significant at 0.10 level | 15 | 28 | 34 | 30 | 26 |
| + Significant at 0.05 level | 9 | 24 | 27 | 23 | 18 |
| + Significant at 0.01 level | 6 | 22 | 23 | 16 | 11 |
| - Significant at 0.10 level | 1 | 14 | 5 | 5 | 3 |
| - Significant at 0.05 level | 1 | 10 | 5 | 3 | 2 |
| - Significant at 0.01 level | 1 | 7 | 5 | 1 | 1 |

Panel D: Emerging Markets

| | No Control | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|---|
| + Significant at 0.10 level | 27 | 35 | 37 | 30 | 23 | 27 |
| + Significant at 0.05 level | 19 | 26 | 29 | 23 | 14 | 22 |
| + Significant at 0.01 level | 9 | 16 | 18 | 13 | 8 | 17 |
| - Significant at 0.10 level | 0 | 2 | 1 | 1 | 3 | 1 |
| - Significant at 0.05 level | 0 | 0 | 1 | 1 | 2 | 1 |
| - Significant at 0.01 level | 0 | 0 | 0 | 0 | 0 | 0 |

| | HXZ | SY4 | DHS† | CharReg | Char |
|---|---|---|---|---|---|
| + Significant at 0.10 level | 20 | 32 | 24 | 19 | 17 |
| + Significant at 0.05 level | 17 | 27 | 22 | 15 | 10 |
| + Significant at 0.01 level | 11 | 23 | 17 | 9 | 7 |
| - Significant at 0.10 level | 2 | 3 | 4 | 4 | 5 |
| - Significant at 0.05 level | 1 | 2 | 3 | 2 | 2 |
| - Significant at 0.01 level | 0 | 1 | 1 | 0 | 0 |

† Post-Earnings Drift is calculated July 2000 and onwards in Emerging Markets. Therefore, DHS results in Emerging Markets begin in July 2000.

## Table 21: Equally-Weighted Factor Portfolio Alpha

This table reports the regional monthly alphas of the equally weighted factor portfolio using the Capital Asset Pricing Model (CAPM), the Fama-French 3-Factor Model (FF3), the Carhart 4-Factor Model (Carhart), the Fama-French 5-Factor Model (FF5), the Novy-Marx 5-Factor Model (NM), the Hou, Xue, and Zhang 4-Factor Model (HXZ), the Daniel, Hirshleifer, and Sun 3-Factor model (DHS), a two-factor model involving the market and a factor built from the expected returns of a linear regression against characteristics using just region returns (CharReg) or using the average of U.S., Developed ex U.S., and Emerging Market returns (Characteristic). All results are from August 1995 to December 2018.

| | CAPM | FF3 | Carhart | FF5 | NM |
|---|---|---|---|---|---|
| Global | 0.18*** | 0.18*** | 0.12*** | 0.12*** | 0.11*** |
| U.S. | 0.18*** | 0.17*** | 0.14*** | 0.08*** | 0.10*** |
| Developed ex U.S. | 0.16*** | 0.15*** | 0.09*** | 0.11*** | 0.08*** |
| Emerging Markets | 0.21*** | 0.20*** | 0.16*** | 0.15*** | 0.15*** |

| | HXZ | SY4 | DHS | CharReg | Char |
|---|---|---|---|---|---|
| Global | 0.12*** | 0.15*** | 0.11*** | 0.11*** | 0.09*** |
| U.S. | 0.11*** | 0.19*** | 0.08*** | 0.07*** | 0.07** |
| Developed ex U.S. | 0.09*** | 0.10*** | 0.13*** | 0.09*** | 0.08*** |
| Emerging Markets | 0.16*** | 0.17*** | 0.15*** | 0.12*** | 0.11*** |

## Table 22: Factors Built from Expected Return

This table builds factors from the top 30% and bottom 30% of expected returns using cross-sectional coefficients. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 85 factor characteristics to predict return. Most recent uses only the most recent set of cross-sectional coefficients.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.77 | 1.35 | 1.06 | 0.81 | 1.88 | 1.34 |
| Volatility | 3.28 | 3.88 | 3.22 | 4.51 | 5.17 | 4.55 |
| Sharpe Ratio | 0.23 | 0.35 | 0.33 | 0.18 | 0.36 | 0.30 |
| t-Stat | 3.93 | 5.81 | 5.50 | 2.99 | 6.09 | 4.95 |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.66 | 0.96 | 0.81 | 0.40 | 1.68 | 1.04 |
| Volatility | 3.71 | 4.61 | 3.74 | 5.69 | 6.31 | 5.73 |
| Sharpe Ratio | 0.18 | 0.21 | 0.22 | 0.07 | 0.27 | 0.18 |
| t-Stat | 2.98 | 3.48 | 3.63 | 1.17 | 4.47 | 3.04 |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.78 | 1.60 | 1.19 | 0.83 | 1.94 | 1.38 |
| Volatility | 3.49 | 4.04 | 3.38 | 4.26 | 5.21 | 4.43 |
| Sharpe Ratio | 0.22 | 0.39 | 0.35 | 0.19 | 0.37 | 0.31 |
| t-Stat | 3.75 | 6.62 | 5.89 | 3.25 | 6.23 | 5.23 |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 1.18 | 1.22 | 1.20 | 0.92 | 1.30 | 1.11 |
| Volatility | 3.98 | 4.74 | 3.72 | 5.05 | 5.59 | 4.76 |
| Sharpe Ratio | 0.30 | 0.26 | 0.32 | 0.18 | 0.23 | 0.23 |
| t-Stat | 4.98 | 4.32 | 5.41 | 3.06 | 3.89 | 3.91 |

## Table 23: Uniqueness of Full Period vs. Recent Period Expected Returns

This table reports the results of regressing long-short portfolios built from expected returns using either inception-to-date average coefficients and most recent coefficients on each other. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 86 factor characteristics to predict return.

Panel A: Global

| | Full Period Against Recent | | | Recent Against Full Period | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.74 | 1.02 | 0.92 | 0.75 | 1.46 | 1.12 |
| Alpha t-stat | 3.71 | 4.23 | 4.62 | 2.70 | 4.59 | 3.97 |
| Beta | 0.04 | 0.18 | 0.10 | 0.07 | 0.31 | 0.21 |
| Beta t-stat | 0.91 | 4.02 | 2.48 | 0.91 | 4.02 | 2.48 |
| R-squared | 0% | 5% | 2% | 0% | 5% | 2% |

Panel B: United States

| | Full Period Against Recent | | | Recent Against Full Period | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.66 | 0.90 | 0.79 | 0.41 | 1.62 | 1.01 |
| Alpha t-stat | 2.98 | 3.17 | 3.50 | 1.19 | 4.22 | 2.89 |
| Beta | -0.01 | 0.03 | 0.01 | -0.02 | 0.06 | 0.03 |
| Beta t-stat | -0.22 | 0.75 | 0.36 | -0.22 | 0.75 | 0.36 |
| R-squared | 0% | 0% | 0% | 0% | 0% | 0% |

Panel C: Developed ex U.S.

| | Full Period Against Recent | | | Recent Against Full Period | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.74 | 1.18 | 1.00 | 0.77 | 1.37 | 1.11 |
| Alpha t-stat | 3.49 | 4.78 | 4.81 | 2.95 | 4.27 | 4.01 |
| Beta | 0.05 | 0.21 | 0.13 | 0.07 | 0.35 | 0.23 |
| Beta t-stat | 0.99 | 4.76 | 2.98 | 0.99 | 4.76 | 2.98 |
| R-squared | 0% | 8% | 3% | 0% | 8% | 3% |

Panel D: Emerging Markets

| | Full Period Against Recent | | | Recent Against Full Period | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 1.07 | 1.06 | 1.08 | 0.69 | 1.08 | 0.90 |
| Alpha t-stat | 4.47 | 3.67 | 4.79 | 2.20 | 3.17 | 3.05 |
| Beta | 0.12 | 0.13 | 0.11 | 0.20 | 0.18 | 0.17 |
| Beta t-stat | 2.66 | 2.52 | 2.28 | 2.66 | 2.52 | 2.28 |
| R-squared | 2% | 2% | 2% | 2% | 2% | 2% |

## Table 24: Factors Built from Expected Return Against an Equal-Weighted Portfolio of Factors

This table reports the results of regressing long-short portfolios built from expected returns using either inception-to-date average coefficients and most recent coefficients on an equally weighted portfolio of factors. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 86 factor characteristics to predict return.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.42 | 0.77 | 0.60 | 0.67 | 1.75 | 1.21 |
| Alpha t-stat | 2.53 | 3.86 | 3.70 | 2.49 | 5.51 | 4.36 |
| Beta | 3.08 | 3.52 | 3.31 | 1.16 | 0.76 | 0.93 |
| Beta t-stat | 11.09 | 11.24 | 12.01 | 2.56 | 1.52 | 1.96 |
| R-squared | 31% | 31% | 34% | 2% | 1% | 1% |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.33 | 0.50 | 0.40 | 0.28 | 1.61 | 0.94 |
| Alpha t-stat | 1.86 | 2.46 | 2.48 | 0.83 | 4.25 | 2.72 |
| Beta | 3.06 | 3.87 | 3.53 | 1.07 | 0.59 | 0.90 |
| Beta t-stat | 12.88 | 15.76 | 15.96 | 2.35 | 1.28 | 1.93 |
| R-squared | 37% | 47% | 48% | 2% | 1% | 1% |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.61 | 1.01 | 0.83 | 0.79 | 1.75 | 1.30 |
| Alpha t-stat | 3.08 | 4.90 | 4.60 | 3.09 | 5.50 | 4.81 |
| Beta | 1.92 | 3.78 | 2.92 | 0.35 | 1.20 | 0.68 |
| Beta t-stat | 5.87 | 11.58 | 9.41 | 0.82 | 2.37 | 1.47 |
| R-squared | 11% | 32% | 24% | 0% | 2% | 1% |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.91 | 0.50 | 0.67 | 0.79 | 1.06 | 0.91 |
| Alpha t-stat | 4.10 | 1.88 | 3.33 | 2.59 | 3.04 | 3.13 |
| Beta | 2.12 | 3.08 | 2.96 | 1.07 | 1.01 | 1.08 |
| Beta t-stat | 7.09 | 8.63 | 9.74 | 2.63 | 2.16 | 2.43 |
| R-squared | 15% | 21% | 25% | 2% | 2% | 2% |

## Table 25: An Equal-Weighted Portfolio of Factors Against Factors Built from Expected Return

This table reports the results of regressing an equally weighted portfolio of factors on long-short portfolios built from expected returns using either inception-to-date average coefficients and most recent coefficients. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 86 factor characteristics to predict return.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.04 | 0.04 | 0.03 | 0.10 | 0.14 | 0.12 |
| Alpha t-stat | 1.21 | 1.38 | 1.06 | 2.75 | 3.68 | 3.41 |
| Beta | 0.10 | 0.09 | 0.10 | 0.02 | 0.01 | 0.01 |
| Beta t-stat | 11.09 | 11.24 | 12.01 | 2.56 | 1.52 | 1.96 |
| R-squared | 31% | 31% | 34% | 2% | 1% | 1% |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.03 | 0.00 | 0.01 | 0.10 | 0.10 | 0.10 |
| Alpha t-stat | 0.76 | 0.06 | 0.16 | 2.28 | 2.02 | 2.25 |
| Beta | 0.12 | 0.12 | 0.14 | 0.02 | 0.01 | 0.01 |
| Beta t-stat | 12.88 | 15.76 | 15.96 | 2.35 | 1.28 | 1.93 |
| R-squared | 37% | 47% | 48% | 2% | 1% | 1% |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.04 | 0.02 | 0.03 | 0.08 | 0.12 | 0.11 |
| Alpha t-stat | 1.23 | 0.60 | 0.81 | 2.24 | 3.24 | 3.04 |
| Beta | 0.06 | 0.09 | 0.08 | 0.01 | 0.02 | 0.01 |
| Beta t-stat | 5.87 | 11.58 | 9.41 | 0.82 | 2.37 | 1.47 |
| R-squared | 11% | 32% | 24% | 0% | 2% | 1% |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.04 | 0.15 | 0.08 | 0.11 | 0.21 | 0.16 |
| Alpha t-stat | 1.01 | 3.89 | 2.26 | 2.42 | 4.96 | 4.14 |
| Beta | 0.07 | 0.07 | 0.09 | 0.02 | 0.02 | 0.02 |
| Beta t-stat | 7.09 | 8.63 | 9.74 | 2.63 | 2.16 | 2.43 |
| R-squared | 15% | 21% | 25% | 2% | 2% | 2% |

## Table 26: Factors Built from Regional Expected Return

This table builds factors from the top 30% and bottom 30% of expected returns using cross-sectional coefficients with coefficients calibrated within region. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 85 factor characteristics to predict return. Most recent uses only the most recent set of cross-sectional coefficients.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.71 | 1.45 | 1.08 | 0.74 | 2.24 | 1.49 |
| Volatility | 3.20 | 3.62 | 3.12 | 4.21 | 5.28 | 4.47 |
| Sharpe Ratio | 0.22 | 0.40 | 0.35 | 0.18 | 0.42 | 0.33 |
| t-Stat | 3.70 | 6.71 | 5.79 | 2.97 | 7.12 | 5.60 |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.56 | 1.12 | 0.84 | 0.44 | 1.76 | 1.10 |
| Volatility | 3.25 | 3.27 | 2.74 | 5.35 | 6.89 | 5.80 |
| Sharpe Ratio | 0.17 | 0.34 | 0.31 | 0.08 | 0.26 | 0.19 |
| t-Stat | 2.90 | 5.76 | 5.14 | 1.37 | 4.29 | 3.18 |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.74 | 1.64 | 1.19 | 0.75 | 2.40 | 1.58 |
| Volatility | 3.59 | 3.63 | 3.36 | 4.25 | 5.54 | 4.59 |
| Sharpe Ratio | 0.21 | 0.45 | 0.36 | 0.18 | 0.43 | 0.34 |
| t-Stat | 3.48 | 7.58 | 5.95 | 2.97 | 7.25 | 5.76 |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.83 | 1.55 | 1.19 | 0.58 | 1.59 | 1.08 |
| Volatility | 3.93 | 4.43 | 3.46 | 4.44 | 6.55 | 4.87 |
| Sharpe Ratio | 0.21 | 0.35 | 0.34 | 0.13 | 0.24 | 0.22 |
| t-Stat | 3.56 | 5.85 | 5.77 | 2.19 | 4.06 | 3.72 |

## Table 27: Factors Built from Expected Return Using All Stocks Regressed Against Factors Built from Expected Return Within Regions

This table reports the results of regressing long-short portfolios built from expected returns predicted using fitting from all stocks on long-short portfolios built from expected returns predicted using fitting within the United States, Developed ex U.S., and Emerging Markets. Both average coefficients from inception-to-date and the most recent coefficients are used to predict return. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 86 factor characteristics to predict return.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.13 | 0.00 | 0.08 | 0.06 | 0.00 | -0.04 |
| Alpha t-stat | 1.38 | 0.00 | 0.79 | 0.63 | -0.01 | -0.37 |
| Beta | 0.90 | 0.93 | 0.91 | 1.00 | 0.84 | 0.93 |
| Beta t-stat | 30.98 | 29.08 | 31.44 | 42.00 | 27.76 | 37.10 |
| R-squared | 77% | 75% | 78% | 86% | 73% | 83% |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.25 | -0.23 | 0.04 | -0.03 | 0.16 | 0.00 |
| Alpha t-stat | 1.45 | -1.21 | 0.24 | -0.27 | 1.23 | 0.01 |
| Beta | 0.73 | 1.06 | 0.91 | 0.99 | 0.86 | 0.94 |
| Beta t-stat | 13.71 | 19.03 | 15.07 | 41.92 | 48.19 | 53.74 |
| R-squared | 40% | 56% | 45% | 86% | 89% | 91% |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.14 | -0.06 | 0.09 | 0.16 | -0.06 | 0.01 |
| Alpha t-stat | 1.41 | -0.49 | 1.02 | 1.31 | -0.41 | 0.11 |
| Beta | 0.86 | 1.01 | 0.92 | 0.88 | 0.83 | 0.87 |
| Beta t-stat | 31.90 | 35.12 | 38.44 | 31.42 | 32.18 | 34.43 |
| R-squared | 78% | 82% | 84% | 78% | 79% | 81% |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.66 | -0.06 | 0.26 | 0.46 | 0.53 | 0.35 |
| Alpha t-stat | 3.45 | -0.31 | 1.63 | 2.12 | 1.88 | 1.73 |
| Beta | 0.63 | 0.83 | 0.79 | 0.80 | 0.48 | 0.70 |
| Beta t-stat | 13.11 | 20.34 | 18.05 | 16.58 | 11.42 | 17.39 |
| R-squared | 38% | 60% | 54% | 50% | 32% | 52% |

## Table 28: Factors Built from Expected Return Within Regions Regressed Against Factors Built from Expected Return Using All Stocks

This table reports the results of regressing long-short portfolios built from expected returns predicted using regressions from all stocks on long-short portfolios built from expected returns predicted using regressions within the United States, Developed ex U.S., and Emerging Markets. Both average coefficients from inception-to-date and the most recent coefficients are used to predict return. All returns are from August 1995 to December 2018. July 1995 expected returns could not be calculated because we cut all data to that date. Full period involves averaging inception-to-date monthly cross-sectional coefficients against 86 factor characteristics to predict return.

Panel A: Global

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.05 | 0.36 | 0.17 | 0.05 | 0.60 | 0.29 |
| Alpha t-stat | 0.50 | 3.15 | 1.88 | 0.49 | 3.46 | 2.55 |
| Beta | 0.86 | 0.81 | 0.85 | 0.87 | 0.87 | 0.90 |
| Beta t-stat | 30.98 | 29.08 | 31.44 | 42.00 | 27.76 | 37.10 |
| R-squared | 77% | 75% | 78% | 86% | 73% | 83% |

Panel B: United States

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.19 | 0.61 | 0.44 | 0.09 | 0.03 | 0.10 |
| Alpha t-stat | 1.28 | 4.66 | 3.56 | 0.76 | 0.20 | 0.92 |
| Beta | 0.55 | 0.53 | 0.49 | 0.87 | 1.03 | 0.97 |
| Beta t-stat | 13.71 | 19.03 | 15.07 | 41.92 | 48.19 | 53.74 |
| R-squared | 40% | 56% | 45% | 86% | 89% | 91% |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.03 | 0.35 | 0.11 | 0.03 | 0.57 | 0.29 |
| Alpha t-stat | 0.32 | 3.47 | 1.30 | 0.22 | 3.49 | 2.29 |
| Beta | 0.91 | 0.81 | 0.91 | 0.88 | 0.94 | 0.93 |
| Beta t-stat | 31.90 | 35.12 | 38.44 | 31.42 | 32.18 | 34.43 |
| R-squared | 78% | 82% | 84% | 78% | 79% | 81% |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Alpha | 0.11 | 0.67 | 0.37 | 0.01 | 0.73 | 0.26 |
| Alpha t-stat | 0.59 | 3.84 | 2.52 | 0.04 | 2.20 | 1.27 |
| Beta | 0.61 | 0.72 | 0.68 | 0.62 | 0.66 | 0.74 |
| Beta t-stat | 13.11 | 20.34 | 18.05 | 16.58 | 11.42 | 17.39 |
| R-squared | 38% | 60% | 54% | 50% | 32% | 52% |

Panel C: Developed ex U.S.

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.74 | 1.64 | 1.19 | 0.75 | 2.40 | 1.58 |
| Volatility | 3.59 | 3.63 | 3.36 | 4.25 | 5.54 | 4.59 |
| Sharpe Ratio | 0.21 | 0.45 | 0.36 | 0.18 | 0.43 | 0.34 |
| t-Stat | 3.48 | 7.58 | 5.95 | 2.97 | 7.25 | 5.76 |

Panel D: Emerging Markets

| | Full Period | | | Most Recent | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.83 | 1.55 | 1.19 | 0.58 | 1.59 | 1.08 |
| Volatility | 3.93 | 4.43 | 3.46 | 4.44 | 6.55 | 4.87 |
| Sharpe Ratio | 0.21 | 0.35 | 0.34 | 0.13 | 0.24 | 0.22 |
| t-Stat | 3.56 | 5.85 | 5.77 | 2.19 | 4.06 | 3.72 |

## Table 29: Annual Return Forward Prediction

This table reports factor excess returns of long-short portfolios built from walk-forward expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on an annual frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.16 | 0.65 | 0.41 | 0.01 | 0.17 | 0.09 |
| Volatility | 2.17 | 2.18 | 1.92 | 2.32 | 1.73 | 1.66 |
| Sharpe Ratio | 0.07 | 0.30 | 0.21 | 0.00 | 0.10 | 0.05 |
| t-Stat | 1.22 | 4.99 | 3.53 | 0.07 | 1.66 | 0.91 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.27 | 0.66 | 0.46 | 0.42 | 0.81 | 0.62 |
| Volatility | 2.54 | 2.47 | 2.23 | 4.89 | 3.60 | 3.74 |
| Sharpe Ratio | 0.11 | 0.27 | 0.21 | 0.09 | 0.22 | 0.16 |
| t-Stat | 1.78 | 4.43 | 3.47 | 1.44 | 3.74 | 2.75 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.09 | 0.60 | 0.34 | 0.05 | 0.27 | 0.16 |
| Volatility | 1.78 | 2.04 | 1.60 | 2.07 | 1.47 | 1.45 |
| Sharpe Ratio | 0.05 | 0.29 | 0.21 | 0.02 | 0.18 | 0.11 |
| t-Stat | 0.82 | 4.87 | 3.55 | 0.36 | 3.03 | 1.80 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.19 | 0.59 | 0.39 | 0.29 | 0.79 | 0.54 |
| Volatility | 1.94 | 2.24 | 1.75 | 4.64 | 3.58 | 3.62 |
| Sharpe Ratio | 0.10 | 0.26 | 0.22 | 0.06 | 0.22 | 0.15 |
| t-Stat | 1.58 | 4.40 | 3.69 | 1.04 | 3.66 | 2.47 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.20 | 0.83 | 0.52 | 0.03 | 0.21 | 0.12 |
| Volatility | 1.84 | 2.32 | 1.81 | 2.29 | 2.26 | 1.82 |
| Sharpe Ratio | 0.11 | 0.36 | 0.28 | 0.01 | 0.09 | 0.06 |
| t-Stat | 1.83 | 5.94 | 4.74 | 0.19 | 1.53 | 1.07 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.23 | 0.79 | 0.51 | 0.86 | 1.12 | 0.99 |
| Volatility | 2.00 | 2.68 | 2.08 | 4.14 | 3.25 | 3.21 |
| Sharpe Ratio | 0.12 | 0.30 | 0.25 | 0.21 | 0.34 | 0.31 |
| t-Stat | 1.93 | 4.94 | 4.10 | 3.45 | 5.72 | 5.12 |

Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.22 | 0.81 | 0.52 | 0.09 | 0.25 | 0.17 |
| Volatility | 1.93 | 2.41 | 1.91 | 2.25 | 2.10 | 1.75 |
| Sharpe Ratio | 0.11 | 0.34 | 0.27 | 0.04 | 0.12 | 0.10 |
| t-Stat | 1.90 | 5.62 | 4.52 | 0.68 | 2.01 | 1.65 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.25 | 0.83 | 0.54 | 0.72 | 1.06 | 0.89 |
| Volatility | 2.17 | 2.72 | 2.20 | 4.45 | 3.47 | 3.52 |
| Sharpe Ratio | 0.11 | 0.30 | 0.24 | 0.16 | 0.30 | 0.25 |
| t-Stat | 1.88 | 5.06 | 4.06 | 2.70 | 5.07 | 4.21 |

## Table 30: Quarterly Return Forward Prediction

This table reports factor excess returns of long-short portfolios built from walk-forward expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on a quarterly frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.42 | 0.98 | 0.70 | 0.21 | 0.28 | 0.24 |
| Volatility | 3.13 | 2.96 | 2.90 | 3.95 | 3.81 | 3.66 |
| Sharpe Ratio | 0.14 | 0.33 | 0.24 | 0.05 | 0.07 | 0.07 |
| t-Stat | 2.27 | 5.55 | 4.06 | 0.89 | 1.24 | 1.12 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.62 | 1.07 | 0.85 | 0.78 | 1.27 | 1.02 |
| Volatility | 3.09 | 3.18 | 2.95 | 4.52 | 3.45 | 3.51 |
| Sharpe Ratio | 0.20 | 0.34 | 0.29 | 0.17 | 0.37 | 0.29 |
| t-Stat | 3.38 | 5.67 | 4.82 | 2.88 | 6.19 | 4.90 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.47 | 1.22 | 0.84 | 0.34 | 0.63 | 0.49 |
| Volatility | 3.25 | 2.93 | 2.89 | 3.83 | 3.82 | 3.53 |
| Sharpe Ratio | 0.14 | 0.42 | 0.29 | 0.09 | 0.17 | 0.14 |
| t-Stat | 2.41 | 6.98 | 4.89 | 1.50 | 2.79 | 2.32 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.52 | 1.24 | 0.88 | 0.87 | 1.34 | 1.10 |
| Volatility | 3.55 | 3.03 | 3.03 | 4.52 | 3.32 | 3.37 |
| Sharpe Ratio | 0.15 | 0.41 | 0.29 | 0.19 | 0.40 | 0.33 |
| t-Stat | 2.46 | 6.89 | 4.89 | 3.22 | 6.75 | 5.49 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.48 | 1.20 | 0.84 | 0.28 | 0.51 | 0.40 |
| Volatility | 3.91 | 3.83 | 3.69 | 4.81 | 4.63 | 4.49 |
| Sharpe Ratio | 0.12 | 0.31 | 0.23 | 0.06 | 0.11 | 0.09 |
| t-Stat | 2.08 | 5.27 | 3.84 | 0.99 | 1.86 | 1.49 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.56 | 1.28 | 0.92 | 1.04 | 1.48 | 1.26 |
| Volatility | 3.72 | 4.03 | 3.67 | 4.94 | 3.98 | 4.01 |
| Sharpe Ratio | 0.15 | 0.32 | 0.25 | 0.21 | 0.37 | 0.31 |
| t-Stat | 2.52 | 5.35 | 4.22 | 3.53 | 6.24 | 5.28 |

Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.51 | 1.20 | 0.85 | 0.22 | 0.45 | 0.34 |
| Volatility | 3.82 | 3.65 | 3.56 | 4.55 | 4.42 | 4.25 |
| Sharpe Ratio | 0.13 | 0.33 | 0.24 | 0.05 | 0.10 | 0.08 |
| t-Stat | 2.25 | 5.50 | 4.03 | 0.83 | 1.73 | 1.34 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.62 | 1.28 | 0.95 | 0.92 | 1.50 | 1.21 |
| Volatility | 3.66 | 3.85 | 3.57 | 4.81 | 3.84 | 3.87 |
| Sharpe Ratio | 0.17 | 0.33 | 0.27 | 0.19 | 0.39 | 0.31 |
| t-Stat | 2.85 | 5.57 | 4.47 | 3.23 | 6.58 | 5.26 |

## Table 31: Monthly Return Forward Prediction

This table reports factor excess returns of long-short portfolios built from walk-forward expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on a monthly frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.51 | 0.95 | 0.73 | 0.34 | 0.47 | 0.40 |
| Volatility | 2.61 | 2.48 | 2.39 | 3.44 | 3.59 | 3.27 |
| Sharpe Ratio | 0.19 | 0.38 | 0.30 | 0.10 | 0.13 | 0.12 |
| t-Stat | 3.26 | 6.40 | 5.12 | 1.65 | 2.19 | 2.07 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.60 | 0.96 | 0.78 | 0.81 | 1.10 | 0.96 |
| Volatility | 2.76 | 2.62 | 2.47 | 4.12 | 3.12 | 3.10 |
| Sharpe Ratio | 0.22 | 0.37 | 0.32 | 0.20 | 0.35 | 0.31 |
| t-Stat | 3.67 | 6.18 | 5.34 | 3.29 | 5.94 | 5.18 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.66 | 1.34 | 1.00 | 0.57 | 0.88 | 0.72 |
| Volatility | 3.27 | 2.81 | 2.84 | 4.05 | 3.92 | 3.69 |
| Sharpe Ratio | 0.20 | 0.48 | 0.35 | 0.14 | 0.22 | 0.20 |
| t-Stat | 3.40 | 8.02 | 5.92 | 2.36 | 3.77 | 3.29 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.68 | 1.32 | 1.00 | 1.21 | 1.47 | 1.34 |
| Volatility | 3.34 | 2.80 | 2.81 | 4.15 | 3.14 | 3.17 |
| Sharpe Ratio | 0.20 | 0.47 | 0.36 | 0.29 | 0.47 | 0.42 |
| t-Stat | 3.41 | 7.92 | 5.98 | 4.90 | 7.86 | 7.10 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.55 | 1.38 | 0.97 | 0.42 | 0.64 | 0.53 |
| Volatility | 3.97 | 3.94 | 3.79 | 4.85 | 4.61 | 4.50 |
| Sharpe Ratio | 0.14 | 0.35 | 0.26 | 0.09 | 0.14 | 0.12 |
| t-Stat | 2.33 | 5.89 | 4.28 | 1.44 | 2.34 | 1.97 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.64 | 1.47 | 1.06 | 1.08 | 1.64 | 1.36 |
| Volatility | 3.78 | 4.16 | 3.78 | 4.66 | 3.98 | 3.92 |
| Sharpe Ratio | 0.17 | 0.35 | 0.28 | 0.23 | 0.41 | 0.35 |
| t-Stat | 2.84 | 5.94 | 4.68 | 3.89 | 6.92 | 5.83 |

Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.60 | 1.37 | 0.99 | 0.53 | 0.69 | 0.61 |
| Volatility | 3.78 | 3.69 | 3.58 | 4.62 | 4.48 | 4.34 |
| Sharpe Ratio | 0.16 | 0.37 | 0.28 | 0.12 | 0.15 | 0.14 |
| t-Stat | 2.67 | 6.24 | 4.62 | 1.94 | 2.60 | 2.38 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.70 | 1.44 | 1.07 | 0.99 | 1.60 | 1.30 |
| Volatility | 3.71 | 3.92 | 3.63 | 4.58 | 3.80 | 3.73 |
| Sharpe Ratio | 0.19 | 0.37 | 0.30 | 0.22 | 0.42 | 0.35 |
| t-Stat | 3.19 | 6.16 | 4.96 | 3.64 | 7.09 | 5.84 |

## Table 32: Annual Return Walk-Around Prediction

This table reports factor excess returns of long-short portfolios built from walk-around expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on an annual frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.14 | 0.49 | 0.32 | 0.04 | 0.09 | 0.06 |
| Volatility | 2.45 | 2.42 | 2.21 | 2.82 | 2.87 | 2.57 |
| Sharpe Ratio | 0.06 | 0.20 | 0.14 | 0.01 | 0.03 | 0.02 |
| t-Stat | 0.97 | 3.37 | 2.38 | 0.22 | 0.50 | 0.40 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| Excess Return | Large | Small | Average | Large | Small | Average |
| Volatility | 0.30 | 0.56 | 0.43 | 0.40 | 0.67 | 0.53 |
| Sharpe Ratio | 2.78 | 2.64 | 2.47 | 4.46 | 3.78 | 3.70 |
| t-Stat | 0.11 | 0.21 | 0.17 | 0.09 | 0.18 | 0.14 |
| | 1.81 | 3.51 | 2.90 | 1.49 | 2.93 | 2.39 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.19 | 0.62 | 0.40 | 0.06 | 0.24 | 0.15 |
| Volatility | 2.01 | 2.15 | 1.82 | 2.07 | 1.82 | 1.57 |
| Sharpe Ratio | 0.09 | 0.29 | 0.22 | 0.03 | 0.13 | 0.09 |
| t-Stat | 1.54 | 4.83 | 3.70 | 0.45 | 2.18 | 1.56 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.31 | 0.64 | 0.47 | 0.50 | 0.79 | 0.64 |
| Volatility | 2.40 | 2.33 | 2.05 | 4.41 | 3.54 | 3.53 |
| Sharpe Ratio | 0.13 | 0.27 | 0.23 | 0.11 | 0.22 | 0.18 |
| t-Stat | 2.12 | 4.54 | 3.83 | 1.88 | 3.70 | 3.02 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.24 | 0.77 | 0.50 | 0.02 | 0.14 | 0.08 |
| Volatility | 2.44 | 2.62 | 2.29 | 2.99 | 3.63 | 2.87 |
| Sharpe Ratio | 0.10 | 0.29 | 0.22 | 0.01 | 0.04 | 0.03 |
| t-Stat | 1.65 | 4.87 | 3.67 | 0.10 | 0.62 | 0.44 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.37 | 0.83 | 0.60 | 0.64 | 0.99 | 0.82 |
| Volatility | 2.66 | 2.79 | 2.39 | 4.45 | 3.32 | 3.42 |
| Sharpe Ratio | 0.14 | 0.30 | 0.25 | 0.14 | 0.30 | 0.24 |
| t-Stat | 2.33 | 4.96 | 4.18 | 2.38 | 4.99 | 3.97 |

Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.24 | 0.74 | 0.49 | 0.02 | 0.17 | 0.10 |
| Volatility | 2.44 | 2.57 | 2.26 | 2.76 | 3.22 | 2.59 |
| Sharpe Ratio | 0.10 | 0.29 | 0.22 | 0.01 | 0.05 | 0.04 |
| t-Stat | 1.64 | 4.79 | 3.61 | 0.14 | 0.87 | 0.62 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.37 | 0.79 | 0.58 | 0.62 | 0.95 | 0.79 |
| Volatility | 2.68 | 2.70 | 2.38 | 4.44 | 3.50 | 3.53 |
| Sharpe Ratio | 0.14 | 0.29 | 0.24 | 0.14 | 0.27 | 0.22 |
| t-Stat | 2.29 | 4.85 | 4.04 | 2.32 | 4.53 | 3.70 |

## Table 33: Quarterly Return Walk-Around Prediction

This table reports factor excess returns of long-short portfolios built from walk-around expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on a quarterly frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.41 | 0.96 | 0.68 | 0.18 | 0.16 | 0.17 |
| Volatility | 3.75 | 3.76 | 3.60 | 4.66 | 4.74 | 4.51 |
| Sharpe Ratio | 0.11 | 0.25 | 0.19 | 0.04 | 0.03 | 0.04 |
| t-Stat | 1.82 | 4.28 | 3.18 | 0.66 | 0.58 | 0.65 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.60 | 1.12 | 0.86 | 0.76 | 1.27 | 1.02 |
| Volatility | 3.52 | 3.79 | 3.48 | 4.29 | 4.01 | 3.69 |
| Sharpe Ratio | 0.17 | 0.30 | 0.25 | 0.18 | 0.32 | 0.28 |
| t-Stat | 2.87 | 4.97 | 4.16 | 2.98 | 5.34 | 4.63 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.51 | 1.30 | 0.90 | 0.32 | 0.56 | 0.44 |
| Volatility | 3.63 | 3.31 | 3.28 | 4.32 | 3.66 | 3.74 |
| Sharpe Ratio | 0.14 | 0.39 | 0.28 | 0.07 | 0.15 | 0.12 |
| t-Stat | 2.35 | 6.58 | 4.62 | 1.25 | 2.58 | 1.99 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.60 | 1.33 | 0.97 | 0.96 | 1.52 | 1.24 |
| Volatility | 3.63 | 3.21 | 3.18 | 4.49 | 3.75 | 3.64 |
| Sharpe Ratio | 0.17 | 0.42 | 0.30 | 0.21 | 0.40 | 0.34 |
| t-Stat | 2.77 | 6.98 | 5.10 | 3.57 | 6.80 | 5.71 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.48 | 1.11 | 0.79 | 0.19 | 0.31 | 0.25 |
| Volatility | 3.99 | 4.43 | 4.02 | 4.61 | 5.07 | 4.57 |
| Sharpe Ratio | 0.12 | 0.25 | 0.20 | 0.04 | 0.06 | 0.05 |
| t-Stat | 2.03 | 4.19 | 3.32 | 0.69 | 1.03 | 0.92 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.62 | 1.31 | 0.97 | 0.94 | 1.42 | 1.18 |
| Volatility | 3.91 | 4.39 | 3.96 | 5.09 | 4.68 | 4.50 |
| Sharpe Ratio | 0.16 | 0.30 | 0.24 | 0.19 | 0.30 | 0.26 |
| t-Stat | 2.66 | 5.02 | 4.10 | 3.11 | 5.09 | 4.41 |

Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.43 | 1.13 | 0.78 | 0.19 | 0.31 | 0.25 |
| Volatility | 3.93 | 4.00 | 3.81 | 4.60 | 4.70 | 4.45 |
| Sharpe Ratio | 0.11 | 0.28 | 0.20 | 0.04 | 0.06 | 0.06 |
| t-Stat | 1.82 | 4.73 | 3.43 | 0.68 | 1.09 | 0.92 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.61 | 1.28 | 0.94 | 0.90 | 1.46 | 1.18 |
| Volatility | 3.82 | 3.95 | 3.70 | 4.85 | 4.27 | 4.15 |
| Sharpe Ratio | 0.16 | 0.32 | 0.26 | 0.18 | 0.34 | 0.28 |
| t-Stat | 2.67 | 5.44 | 4.29 | 3.10 | 5.72 | 4.76 |

## Table 34: Monthly Return Walk-Around Prediction

This table reports factor excess returns of long-short portfolios built from walk-around expected returns using linear ridge, gradient boosting, random forest, and a linear ensemble of the four models. Average refers to an equally weighted portfolio of the large and small factor portfolios. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018. Returns are predicted on a monthly frequency.

Panel A: Linear Ridge

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.52 | 0.99 | 0.76 | 0.39 | 0.45 | 0.42 |
| Volatility | 3.25 | 3.24 | 3.10 | 4.21 | 4.32 | 4.05 |
| Sharpe Ratio | 0.16 | 0.31 | 0.24 | 0.09 | 0.11 | 0.10 |
| t-Stat | 2.71 | 5.12 | 4.09 | 1.54 | 1.76 | 1.74 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.59 | 1.07 | 0.83 | 0.68 | 1.09 | 0.89 |
| Volatility | 3.07 | 3.27 | 2.98 | 3.84 | 3.58 | 3.24 |
| Sharpe Ratio | 0.19 | 0.33 | 0.28 | 0.18 | 0.30 | 0.27 |
| t-Stat | 3.24 | 5.52 | 4.70 | 2.98 | 5.11 | 4.59 |

Panel B: Gradient Boosting

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.69 | 1.39 | 1.04 | 0.51 | 0.84 | 0.67 |
| Volatility | 3.31 | 2.94 | 2.94 | 3.85 | 3.43 | 3.38 |
| Sharpe Ratio | 0.21 | 0.47 | 0.35 | 0.13 | 0.24 | 0.20 |
| t-Stat | 3.51 | 7.95 | 5.94 | 2.20 | 4.11 | 3.34 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.73 | 1.37 | 1.05 | 1.32 | 1.54 | 1.43 |
| Volatility | 3.49 | 2.87 | 2.95 | 4.28 | 3.37 | 3.37 |
| Sharpe Ratio | 0.21 | 0.48 | 0.36 | 0.31 | 0.46 | 0.42 |
| t-Stat | 3.53 | 8.04 | 5.99 | 5.18 | 7.69 | 7.13 |

Panel C: Random Forest

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.61 | 1.23 | 0.92 | 0.28 | 0.43 | 0.35 |
| Volatility | 4.15 | 4.46 | 4.12 | 4.75 | 5.23 | 4.74 |
| Sharpe Ratio | 0.15 | 0.28 | 0.22 | 0.06 | 0.08 | 0.07 |
| t-Stat | 2.48 | 4.64 | 3.76 | 0.99 | 1.38 | 1.25 |

| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.75 | 1.47 | 1.11 | 1.09 | 1.56 | 1.32 |
| Volatility | 4.05 | 4.43 | 4.04 | 5.00 | 4.63 | 4.45 |
| Sharpe Ratio | 0.19 | 0.33 | 0.27 | 0.22 | 0.34 | 0.30 |
| t-Stat | 3.12 | 5.56 | 4.61 | 3.65 | 5.66 | 5.00 |

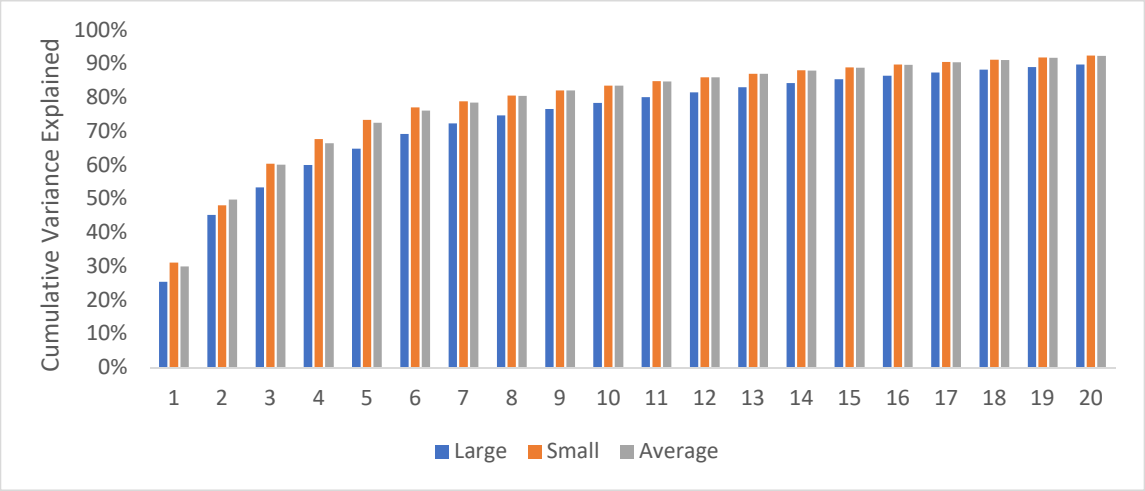
Panel D: Ensemble

| | Global | | | United States | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.61 | 1.27 | 0.94 | 0.36 | 0.55 | 0.45 |
| Volatility | 3.86 | 3.96 | 3.74 | 4.45 | 4.70 | 4.35 |
| Sharpe Ratio | 0.16 | 0.32 | 0.25 | 0.08 | 0.12 | 0.10 |
| t-Stat | 2.65 | 5.39 | 4.22 | 1.34 | 1.97 | 1.75 |

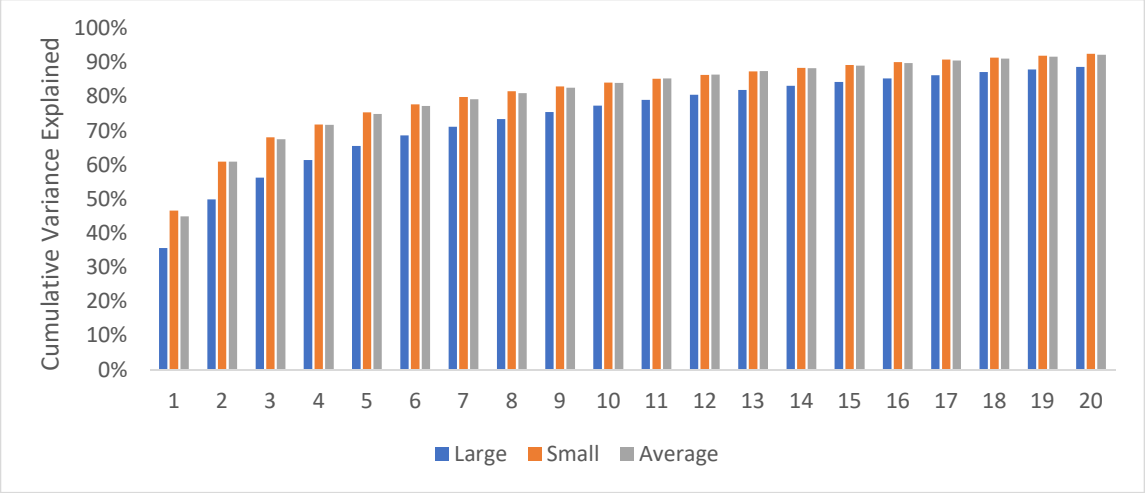
| | Developed ex U.S. | | | Emerging Markets | | |
|---|---|---|---|---|---|---|
| | Large | Small | Average | Large | Small | Average |
| Excess Return | 0.71 | 1.41 | 1.06 | 1.09 | 1.55 | 1.32 |
| Volatility | 3.84 | 3.89 | 3.67 | 4.61 | 4.16 | 4.00 |
| Sharpe Ratio | 0.18 | 0.36 | 0.29 | 0.24 | 0.37 | 0.33 |
| t-Stat | 3.11 | 6.10 | 4.85 | 3.96 | 6.26 | 5.54 |

Figure 1: PCA Variance Explained

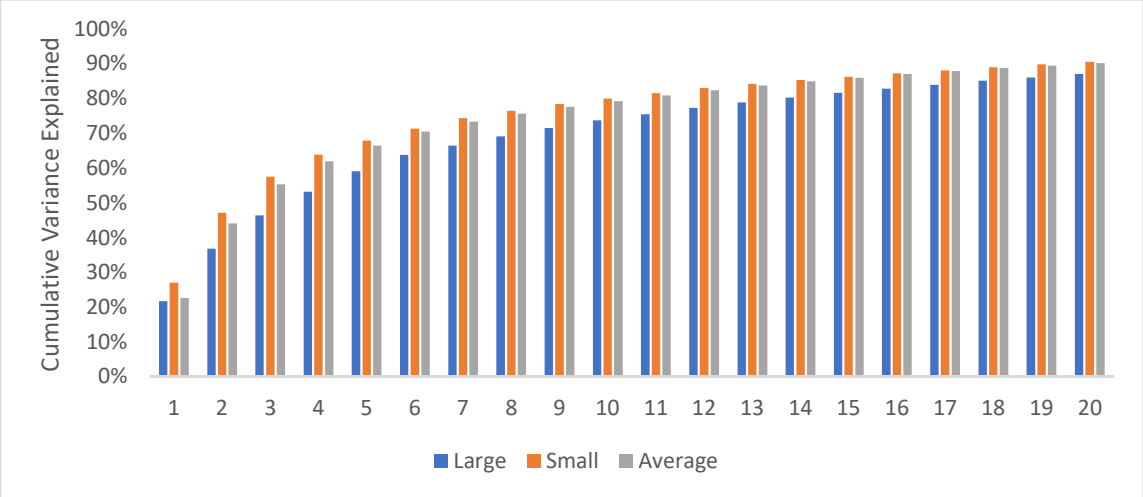
Panel A: Global



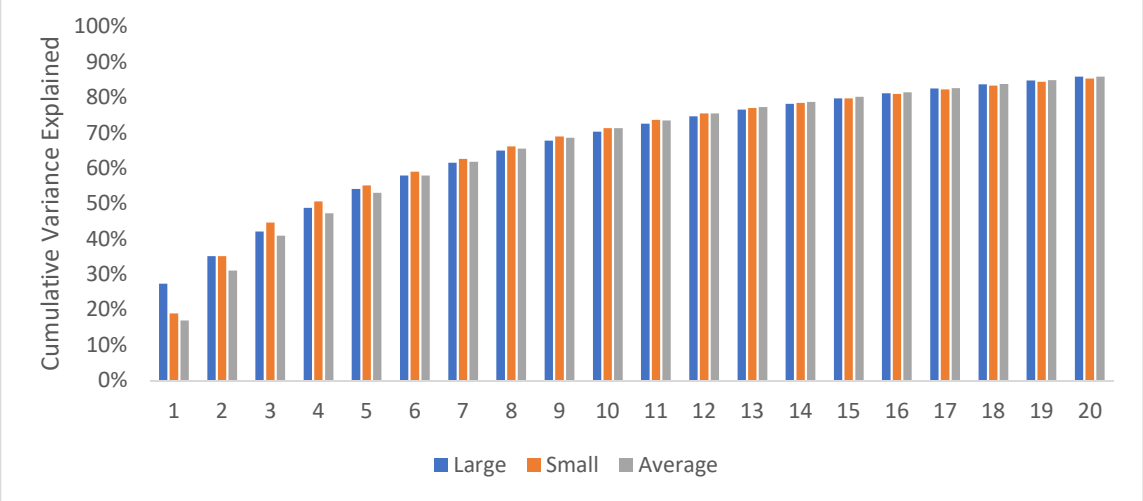

Panel B: United States



Panel C: Developed ex US




Panel D: Emerging Markets




The figures show the cumulative variance explained by principal components of factor returns. Large portfolios include firms above 60th percentile NYSE market capitalization. Small portfolios include firms between 20th and 60th percentile NYSE market capitalization. Country inclusion in developed ex U.S. and emerging markets uses classifications from MSCI World and MSCI Emerging Markets, respectively. Returns are calculated between July 1995 and December 2018 except for Post Earnings Drift in Emerging Markets, which is calculated from July 2000 to June 2018; Pension Funding, which is calculated from July 2001 in all regions; and G-Score, which is calculated from July 2001 in Emerging Markets and Developed ex U.S. and from July 2000 in the U.S. and globally. Factors include all calculable factors from and are categorized using McLean and Pontiff (2016).